ROUSH CLEANTECH

2009 - 2011

Ford E-150 / E-250 / E-350

LIQUID PROPANE AUTOGAS

Rev. 02/11/2011

SERVICE MANUAL SUPPLEMENT

FOREWORD

This manual is a supplement to the Ford E-150/250/350 Workshop Manuals (referenced as the "Ford WSM" where applicable in this manual). It is intended to provide technicians with the procedures required to maintain and service the unique components of the ROUSH CleanTech E-150/250/350 Liquid Propane Autogas vehicles. Service procedures for vehicle components shared in common with Ford E-150/250/350 vehicles will be referenced to and covered in the Ford Workshop Manual.

This manual supplement includes a Table of Contents to direct you to the information contained within.

LIMITED LIABILITY DISCLAIMER

The information in this publication was accurate and effective at the time the publication was approved for printing and is subject to change without notice or liability. ROUSH CleanTech reserves the right to revise the information herein and to make changes and discontinue production of described parts at any time.

Current as of 02/11/2011

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INTRODUCTION

General Information

This manual applies to the following ROUSH CleanTech Liquid Propane Autogas applications:

- 2009–2011 E-150/E-250/E-350 5.4L-2V

This manual is a supplement to the regular Ford Workshop Manual, covering the unique components of the ROUSH CleanTech Liquid Propane Autogas system:

- Fuel supply line
- Fuel return line
- Fuel Rail Pressure Control Module (FRPCM)
- Fuel rails
- Fuel filler lines, valve and filter
- Fuel tank

The ROUSH CleanTech parts generally serve the same functions as the Ford parts they replace.

The online Ford Workshop Manual, if available, continues to apply to all other details. The diagnostic chart in this manual directs the technician to appropriate sections of the Ford manual for applicable remedies in some situations.

Propane, like other fuels, must be handled safely with knowledge of its characteristics. Training in propane characteristics and handling is available through the Propane Education and Research Council (PERC), 1140 Connecticut Avenue, Washington, DC 20036. Their web address is www.propanecouncil.org.

ROUSH CleanTech Technical Assistance

Call ROUSH CleanTech Customer Service at 1-800.59.ROUSH with any questions regarding ROUSH CleanTech Liquid Propane Autogas systems.

Start Sequence

The ROUSH CleanTech Liquid Propane Autogas system is fully integrated with Ford's One Touch Starting system. The vehicle operator turns the key to the ***Start*** position and releases it. The computer senses the pressure/temperature in the fuel lines and starts the fuel pump. The pump sends liquid propane through the lines driving the vapor back to the tank to become liquid again. When the pressure/temperature sensor reports that the lines are full of liquid, the computer energizes the starter and the ignition system. The entire sequence generally takes from 1.5 to 10 seconds (may extend to 20 seconds under extreme ambient conditions).

Fill Stations

Propane is readily available anywhere in the United States. To locate the nearest station, check with http://www.afdc.energy.gov/afdc/locator/stations/.

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ROUSH CleanTech recommends facilities designed for automotive refueling. Other locations may have low output pumps, resulting in slow or no fill, or low quality fuel which can result in premature component failure.

Range and Fuel Economy

Propane contains less energy per unit volume then gasoline. Therefore, customers will generally experience fuel economy (mile per gallon) 15–30% lower than gasoline.

Vehicle range will vary based on driving conditions and loading.

Safety Information

The National Fire Protection Association (NFPA) publishes a code book of rules that apply to the storage, handling, transportation, and use of liquefied petroleum gas (LP-Gas or LPG). The book is known as NFPA 58. It is revised as necessary and published every other year. This code is adopted as law in virtually every political subdivision in the United States. Check with your local authorities for regulations applicable to liquid propane.

Alert Messages

The following alert messages appear from time to time inappropriate places in this manual. Ensure that all personnel in the immediate area are aware of these reminders.

⚠ **Danger:** Although propane is nontoxic, nonpoisonous, has the lowest flammability range of any alternative fuel and dissipates quickly when released into the atmosphere, propane vapor is heavier than air and seeks the lowest point. When the ratio of propane to air is between 2.2% and 9.6%, propane will burn in the presence of an ignition source at 940°F (504°C) or hotter. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Failure to heed this danger may result in severe personal injury or death.

⚠ **Danger:** The fuel supply lines remain pressurized after engine shutdown. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Do NOT enter storage areas or confined space unless they are adequately ventilated. Failure to heed this danger may result in severe personal injury or death.

⚠ **Danger:** Do NOT carry lighted smoking materials or smoke while working on fuel system components. Failure to heed this danger could result in severe personal injury or death.

⚠ **Danger:** Disconnect the battery ground at the battery to ensure that the vehicle electrical system has no current. Failure to heed this danger could result in severe personal injury or death.

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Installation, Garaging and Training

Chapter 11 of NFPA 58 applies to engine fuel systems using LP-Gas in internal combustion engines, including containers, container appurtenances, carburetion equipment, piping, hose and fittings and their installation. Additionally, this chapter applies to garaging of vehicles and to the training of personnel.

Paragraph 11.2 specifies that each person engaged in installing, repairing, filling or otherwise servicing an LP-Gas engine fuel system shall be trained. Contact the Propane Education and Research Council to learn more about their CETP E-Learning computer-based training program: stuart.flatow@propanecouncil.org, or vincent.sibilia@propanecouncil.org.

Purging and Venting (Tanks and Lines)

Venting of LP-Gas to the atmosphere is covered by paragraphs 7.3.1, General, and 7.3.2, Purging of NFPA 58, 2008 edition. Refer to NFPA 58, Local Codes and Proper Training for specific information relating to safe venting of LPG.

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VEHICLE INFORMATION

Build Data

ROUSH CleanTech emissions certification information is recorded on the ROUSH CleanTech Vehicle Emissions Control Information (VECI) label. The label is vehicle-specific and is required by law to be on the vehicle to which it is assigned along with the Ford VECI label.

Vehicle Emissions Control Information (VECI) Labels

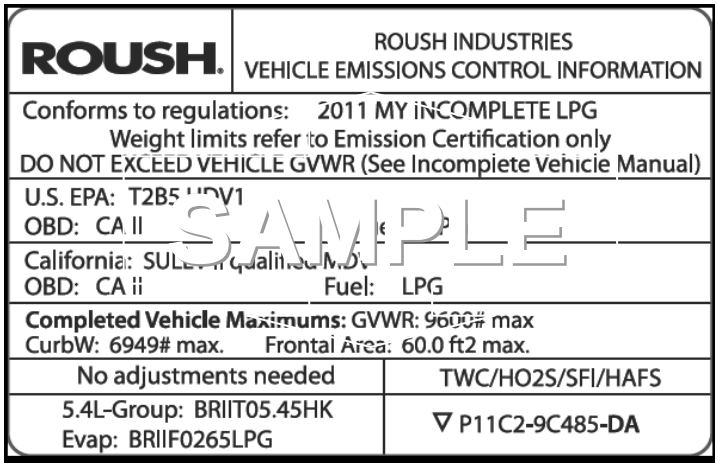

Figure 1 — ROUSH CleanTech VECI Label (Typical)

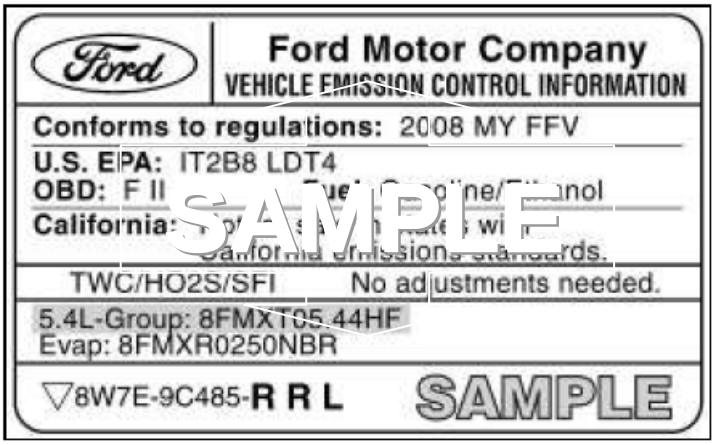

Figure 2 — Ford VECI Label (Typical)

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VECI Label Location

The ROUSH CleanTech VECI label appears along with the original Ford VECI label in the following location:

- **E-Series** — under hood at front, passenger side

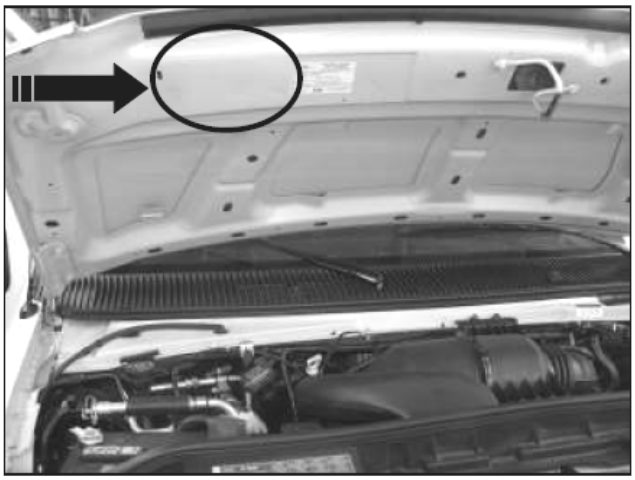

Figure 3 — VECI Label Location

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DESCRIPTION AND OPERATION

System Overview

The ROUSH CleanTech Liquid Propane Autogas (LPA) system consists of a propane fuel tank, fuel pump, fuel rails and lines, injectors and electronic controls. The system is simple and easily serviced with no user adjustment required.

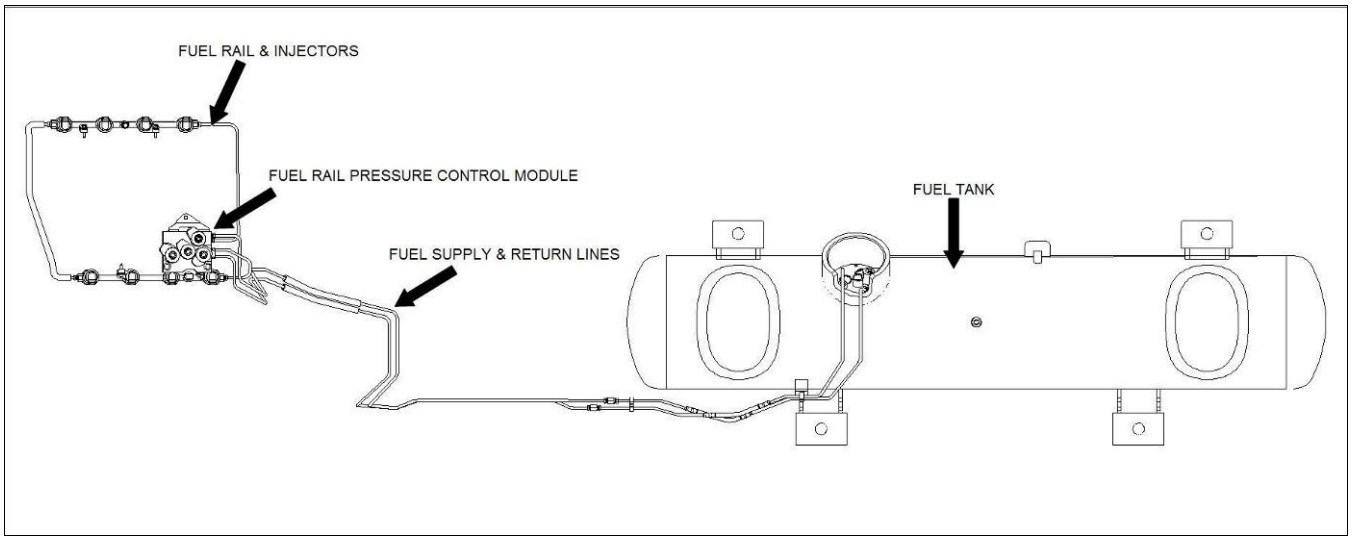

Figure 4 — LPI Fuel System (Typical)

Propane is stored in the vehicle fuel tank under pressure as a liquid. The pressure in the tank is determined by the temperature of the fuel, ranging from 0 psi at minus 44°F, to 312 psi at 145°F. The tank has an overpressure safety device which vents the tank at pressures over 312 psi.

There are three propane filters in the system. The primary filter is located in the fuel fill line which is intended to filter out the majority of contaminants that may be present in the fuel. The primary filter must be replaced every 50,000 miles. A secondary fuel filter is located after the fuel pump inside the tank which is intended to ensure that no contaminants reach the fuel injectors. The third filter is a sock filter located at the bottom of the fuel pump (fuel pump inlet).

ROUSH CleanTech LPA vehicles require HD-5 propane, rated for automotive use. Use of HD-10 or other substandard propane may result in excess contamination of the system and failure of the fuel pump, injectors and in-tank filter.

A pump inside the tank delivers liquid propane to the injectors through the fuel supply line and the fuel rails. Excess fuel flows back to the tank through the fuel return line. Fuel pressure is regulated by the Flow Control Solenoid (FCS) which includes a small orifice to restrict return flow in normal conditions; and a bypass circuit to allow maximum fuel flow prior to engine starting or during extremely hot conditions. The FCS is integrated into the Fuel Rail Pressure Control Module (FRPCM) in E-Series applications.

In order to safely store pressurized liquid propane in the vehicle, the fill system must ensure that the tank is not filled beyond 80% of its total volume. This ensures that sufficient expansion volume is present in case of significant tank temperature changes.

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The fuel fill system includes the following components:

1. Fuel fill valve, cap and mounting bracket
2. Fuel fill hoses
3. Fuel fill filter
4. Fuel tank internal components
   a. Fuel fill solenoid
   b. Fill pressure switch
   c. 80% level sensor

During a fill event, the system functions as follows:

1. Customer connects fuel filler nozzle to fill valve and activates the fuel pump.
2. Fuel pressure in the fill line causes the pressure switch to close. In order for the switch to close, pressure in the fill line must be at least 10 psi higher than tank pressure, otherwise no fill is possible.
3. The fill pressure switch provides a ground to the 80% level sensor to activate the circuit. If the fuel level is below the 80% level, the sensor provides ground to the fuel fill solenoid, allowing fuel to enter the tank.
4. Once the fuel reaches the 80% fill level, the 80% level sensor de-activates, causing the fill solenoid to close.

   Note — Some fuel pumps may have sufficient pressure to allow a small fuel flow into the tank even with the fill solenoid closed. The operator should stop the fill as soon the fuel flow drops noticeably.

Vehicle Starting

The ROUSH CleanTech LPA system is fully integrated using Ford's One Touch Integrated Start (OTIS) system. When the ignition key is turned to crank and released to the ON position, the PCM opens the Flow Control Solenoid (FCS) and engages the fuel pump. As soon as the fuel rail temperature and pressure are acceptable to ensure liquid fuel at the injectors, the starter engages and the vehicle starts with no further action required from the operator. This delay period is usually less than 5 seconds, but may be up to 30 seconds in extremely hot conditions. During the delay period, the wrench light on the dash blinks to signal that the system is active.

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System Components and Function

Fuel Rails and Injectors

The Ford OEM fuel rails and injectors are replaced with ROUSH CleanTech LPA fuel rail and injector assemblies, including injection pressure and temperature sensor (IPTS), Schrader port for service and crossover fuel line. On E-Series vehicles only, the LPA system also incorporates a Fuel Rail Pressure Control Module (FRPCM) mounted at the top rear of the engine.

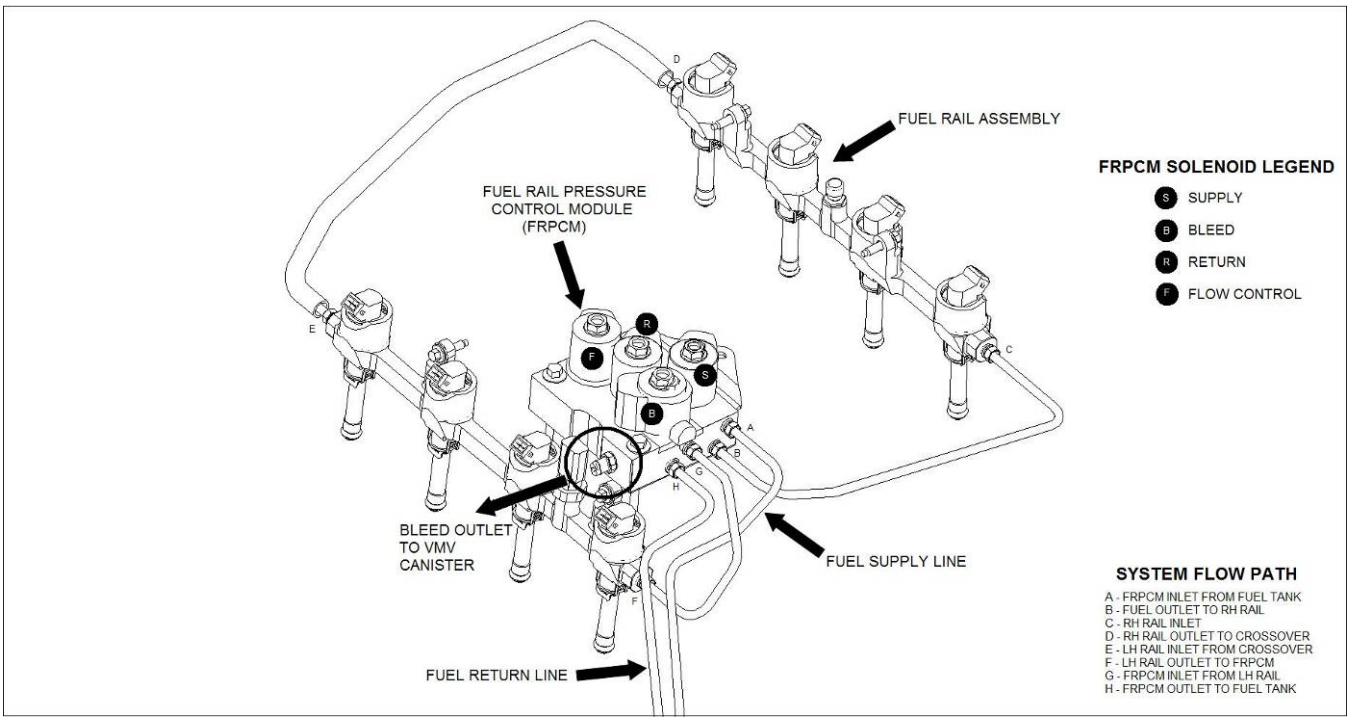
FUEL RAIL ASSEMBLY
FUEL RAIL PRESSURE CONTROL MODULE (FRPCM)
FRPCM SOLENOID LEGEND
S SUPPLY
B BLEED
R RETURN
F FLOW CONTROL
BLEED OUTLET TO VMV CANISTER
FUEL SUPPLY LINE
FUEL RETURN LINE
SYSTEM FLOW PATH
A - FRPCM INLET FROM FUEL TANK
B - FUEL OUTLET TO RH RAIL
C - RH RAIL INLET
D - RH RAIL OUTLET TO CROSSOVER
E - LH RAIL INLET FROM CROSSOVER
F - LH RAIL OUTLET TO FRPCM
G - FRPCM INLET FROM LH RAIL
H - FRPCM OUTLET TO FUEL TANK

Figure 5 — Fuel Rails and Injectors with FRPCM (Early Applications)

The FRPCM is a unit consisting of four normally closed solenoids controlled by a separate electronic control module. The FRPCM is controlled directly by the Smart Relay Module (SRM) which is in turn controlled by the PCM. Included in the FRPCM are:

Supply Solenoid — Open (energized) when the engine is running, the supply solenoid allows fuel to flow from the vehicle fuel tank to the fuel rail. The supply solenoid is closed when the engine is turned off, preventing fuel from flowing from the vehicle fuel tank to the engine fuel rail.

Note — There is a second supply solenoid located at the fuel tank which prevents fuel from flowing into the chassis fuel lines when the engine is turned off.

Return Solenoid — Open when the engine is running, the return solenoid allows fuel to return from the fuel rails to the fuel tank. The solenoid remains open for approximately 15 seconds after the engine is turned off, allowing pressure in the fuel rails to return to the fuel tank.

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Flow Control Solenoid — The flow control solenoid is located in the return line. During normal engine operation, the solenoid is closed, which inserts a metered orifice in the fuel return path. This results in increased pressure at the fuel rail (similar to a conventional pressure regulator). Prior to and immediately following engine start and in extremely hot fuel conditions, the FCS opens, which removes the orifice and allows higher flow rate to flush fuel through the rail.

Bleed Solenoid — Closed when the engine is running, the bleed solenoid seals the fuel rail from the vehicle EVAP system. After the engine is turned off for approximately one hour, the bleed solenoid opens for a calibrated length of time allowing all the pressure to bleed from the fuel rail. When pressure is fully bled off, the solenoid closes, preventing fuel from entering the EVAP system.

Injection Pressure and Temperature Sensor (IPTS)

The IPTS is used to monitor fuel pressure and temperature. On E-Series applications the IPTS is read by the SRM and communicated to the PCM over CAN.

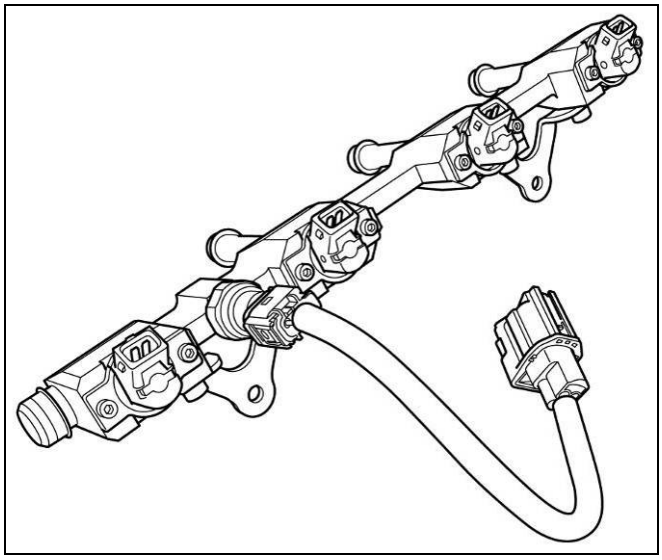

Figure 6 — Injection Pressure and Temperature Sensor

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Fuel Supply and Return Lines

The Ford OEM fuel lines are replaced with formed stainless steel lines following the original production line routings. The formed lines are produced in many lengths and configurations to accommodate the various vehicle models. The lines may be installed with two or three sectioned assemblies depending on the specific vehicle model. All sections, supply and return, include unions as part of the assembly.

The stainless steel fuel lines are retained in the chassis using the Ford OEM retention clips.

Figure 7 — Stainless Fuel Supply and Return Lines (Typical)

Fuel Tank

Different tank configurations are used based on the vehicle model. A long cylindrical tank mounted under the vehicle is used for the E-150/250/350 LPA vehicles. The tank is bolted to the left frame side rail and to two crossmembers.

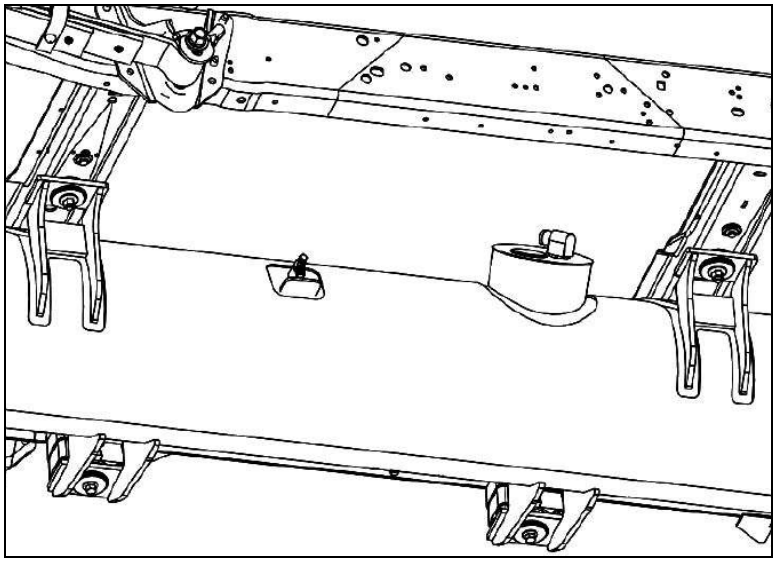

Figure 8 — Fuel Tank, Under-Vehicle Configuration

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All ROUSH CleanTech LPA vehicle fuel tanks regardless of configuration are fitted with the same valve assemblies and control units. These include the Multivalve assembly, Fuel Control Solenoid (integrated in FRPCM), Fuel Fill Solenoid, 80% Level Sensor, Fill Pressure Switch and the Fuel Level Sending Unit.

Multivalve

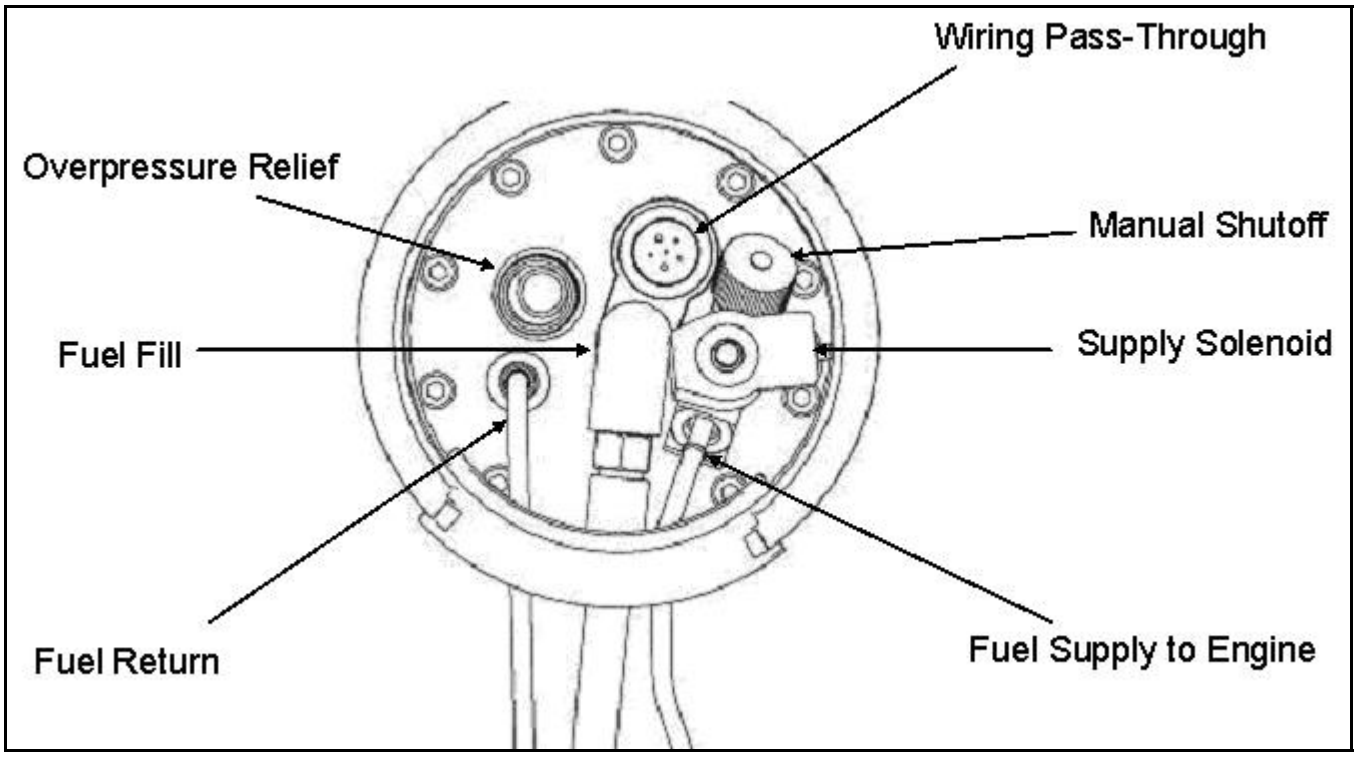

Figure 9 — Multivalve Assembly

The Multivalve attaches directly to the fuel tank and serves as the main interface between fuel tank and vehicle. As the name implies, the Multivalve consists of a number of valves incorporated into one unit. The included valves are:

Fill Valve — Located where fuel enters into the fuel tank, the fill valve is opened electrically by the Fuel Fill Solenoid during the fill process. It also incorporates double back redundant check valves which close when vehicle tank pressure is greater than pressure outside of tank to prevent fuel from escaping.

Manual Shutoff Valve — This manually-operated valve is used to seal the outlet of the tank during shipping or service. It should always be open when the vehicle is operating.

Excess Flow Valve — The excess flow valve is located in the supply fuel path. The valve is intended to shut off fuel flow from the tank in case the supply line comes off of the tank. If the excess flow valve trips (may happen after servicing the system), it can be reset by closing the manual shutoff valve and then slowly opening it.

Pressure Relief Valve — When conditions cause tank pressure to rise to 312 psi, this valve automatically opens to relieve the excessive pressure inside of the vehicle fuel tank. Propane vapor is vented out of the pressure relief hose.

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Fuel Supply Valve — The fuel supply valve is controlled by the PCM and is activated whenever power is supplied to the fuel pump.

Fuel Return Check Valve — The fuel return line is protected by a check valve in the Multivalve which prevents fuel from flowing from the tank into the return line.

Fuel Level Sending Unit

The Fuel Level Sending Unit is located inside of the fuel tank and consists of a float on an arm with a wound resistor. The sending unit resistance is used by the instrument cluster to indicate fuel level and by the PCM. It is not used in the fill system.

Fuel Filler Valve and Fill Line

The fuel fill line includes the fuel port with fill valve, the fill line hose and a fuel filter.

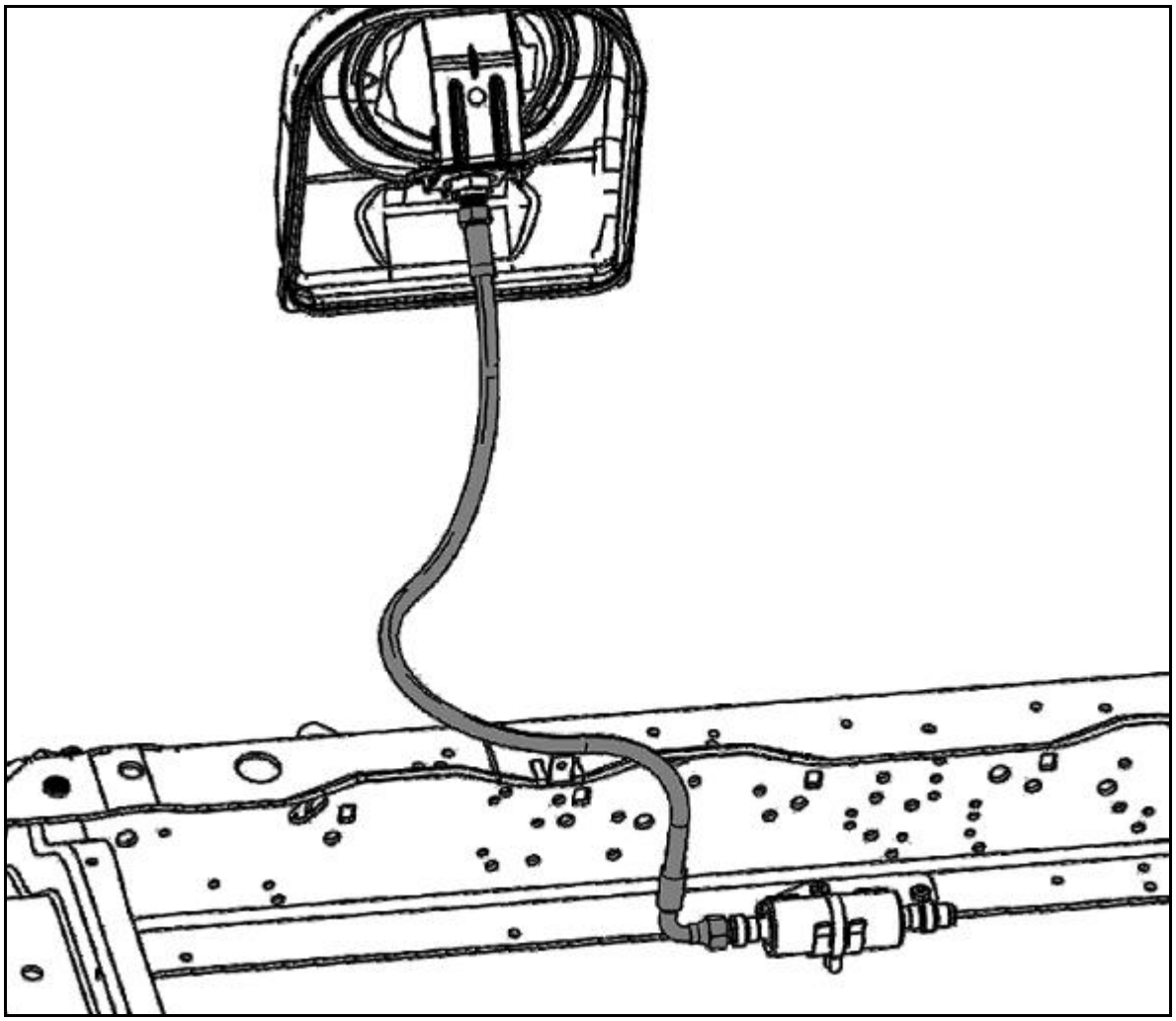

Figure 10 — Fuel Filler Neck, Fill Line and Fuel Filter

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FILL VALVE

The Fill Valve serves as the fuel fill inlet to the vehicle fuel tank. This is where the fill station hose attaches while fueling and the fuel cap attaches during vehicle operation. It is a one way single back check valve that opens during the fuel fill process and closes when fueling is complete, to minimize fuel from escaping.

IN-LINE FILTER

The fuel filter is located in the fuel fill line to filter fuel from the fill station before it enters the vehicle fuel tank. The filter is field serviceable and should be replaced every 50,000 miles.

Glossary

80% Level Sensor — An infrared sensor designed to detect the presence of liquid. The sensor is located inside the vehicle fuel tank at the 80% full level.

Bleed Solenoid — Closed when the engine is running, sealing the fuel rail from the vehicle EVAP system. After the engine is turned off for approximately one hour, the Bleed Solenoid opens for a calibrated length of time allowing pressure to bleed from the fuel rails. When pressure is fully bled off, the solenoid closes, preventing fuel from entering the EVAP system. The bleed solenoid is located in the FRPCM.

Fill Pressure Switch — A normally open pressure sensing switch. The switch is attached to the Multivalve, internal to the vehicle fuel tank and used to sense pressure of the fuel coming into the vehicle fuel tank from the fill station.

Fill Valve — Located where fuel enters into the vehicle fuel tank. During the fill process, the valve is opened electrically by the Fuel Fill Solenoid. The valve also incorporates double back redundant check valves that close when vehicle fuel tank pressure is greater than the pressure outside of the tank to prevent fuel from escaping. The valve is part of the Multivalve.

Fuel Control Solenoid — Closed when the engine is running, but still allows fuel to flow through a metered orifice back to the vehicle fuel tank. The solenoid is opened for approximately 15 seconds after the engine is turned off to allow pressure in the fuel rails to return to the vehicle fuel tank. The solenoid may also be opened to flush the fuel rails to ensure that there is liquid fuel in the fuel rails during hot operating conditions. On E-Series vehicles, the solenoid is part of the FRPCM.

Fuel Fill Filter — In-line between the Fill Valve and the fuel tank to filter fuel before entering the vehicle fuel tank during the fill process.

Fuel Fill Solenoid — Electrically-operated solenoid used to allow fuel to enter the vehicle fuel tank during fills. The solenoid is located inside of the vehicle fuel tank and is attached to the Multivalve.

Fuel Level Sending Unit — Located inside of the vehicle fuel tank to indicate fuel level. The unit consists of a float on an arm with a wound resistor.

Fuel Rail Pressure Control Module (FRPCM) — Module consisting of four normally closed solenoids controlled by a separate electronic control module. The FRPCM is mounted on the engine. The module is used only in E-Series vehicles.

Fuel Return Check Valve — Ensures fuel does not escape from vehicle tank if there is a leak in the fuel return line external to the tank. The valve is part of the Multivalve.

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Fuel Supply Valve — Opened electrically by the Fuel Control Solenoid to provide fuel to the engine. Also incorporates an excess flow control valve to minimize fuel escaping if there is a leak in the fuel supply line external to the tank. The valve is part of the Multivalve.

Injection Pressure and Temperature Sensor (IPTS) — Mounted on the fuel rail, the IPTS is used to monitor pressure and temperature of the fuel.

Manual Shutoff Valve — Manually operated valve that is used to seal the outlet of the vehicle fuel tank during shipping or service. The valve should always be open when the vehicle is operating. The valve is part of the Multivalve.

Multivalve — Mounted directly on the vehicle fuel tank and serves as the main interface between fuel tank and vehicle. The Multivalve consists of five valves incorporated into one unit which includes the Fill Valve, the Manual Shutoff Valve, the Pressure Relief Valve, the Fuel Supply Valve and the Fuel Return Check Valve. Also attached to, but not part of the Multivalve, are the Fill Pressure Switch and the Fill Control Solenoid which are both internal to the tank.

Pressure Relief Valve — Automatically opens to relieve excessive pressure inside of the vehicle fuel tank. The valve is part of the Multivalve.

Return Solenoid — Open when the engine is running, the return solenoid allows fuel from the fuel rails to return to the vehicle fuel tank. The solenoid remains open for approximately 15 seconds after the engine is turned off, allowing pressure in the fuel rails to return to the vehicle fuel tank. The solenoid is part of the FRPCM.

Fill Valve — Serves as the fuel fill inlet to the vehicle fuel tank for attachment of the fill station hose. The valve is a one way single back check valve that opens during the fuel fill process and closes when fueling is complete to minimize fuel from escaping.

Supply Solenoid — Solenoid that is open (energized) when the engine is running, allowing fuel to flow from the vehicle fuel tank to the fuel rails. The solenoid is closed when the engine is turned off, preventing fuel from flowing from the vehicle fuel tank to the fuel rails. The solenoid is part of the FRPCM.

Smart Relay Module — Module that controls the actuation of the four solenoid valves in the fuel rail pressure control module.

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COMPONENT LOCATOR

Engine Compartment

Fuel Rail Pressure Control Module (FRPCM), Rails and Injectors

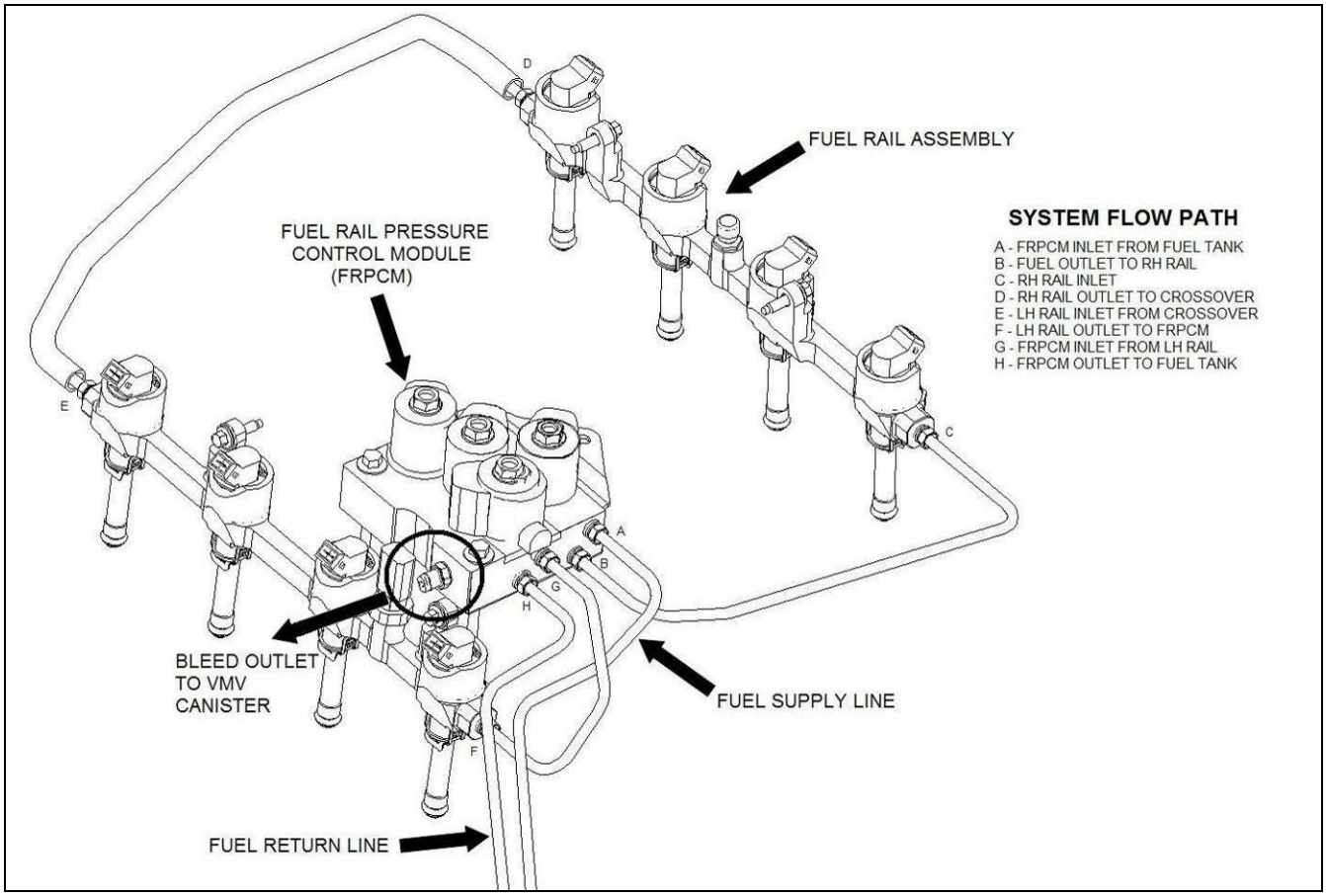
FUEL RAIL ASSEMBLY
FUEL RAIL PRESSURE CONTROL MODULE (FRPCM)
SYSTEM FLOW PATH
A - FRPCM INLET FROM FUEL TANK
B - FUEL OUTLET TO RH RAIL
C - RH RAIL INLET
D - RH RAIL OUTLET TO CROSSOVER
E - LH RAIL INLET FROM CROSSOVER
F - LH RAIL OUTLET TO FRPCM
G - FRPCM INLET FROM LH RAIL
H - FRPCM OUTLET TO FUEL TANK
BLEED OUTLET TO VMV CANISTER
FUEL SUPPLY LINE
FUEL RETURN LINE

Figure 11 — Fuel Rails and Injectors (Early Applications)

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Chassis

Fuel Lines and Tank

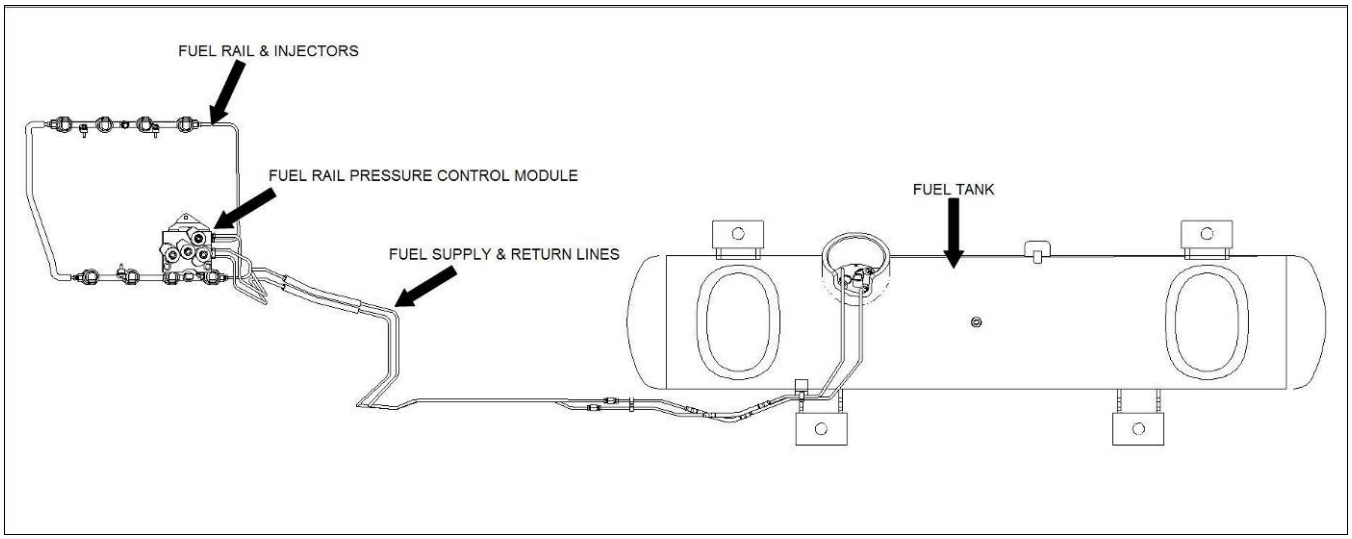


Figure 12 — Fuel Lines and Tank (Typical)

Current as of 02/11/2011

TROUBLESHOOTING

Symptom Tables

Fuel Odor

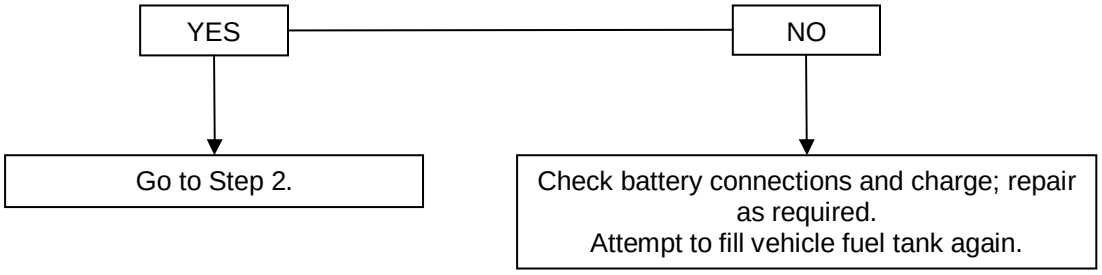
(Content to be developed)

Current as of 02/11/2011

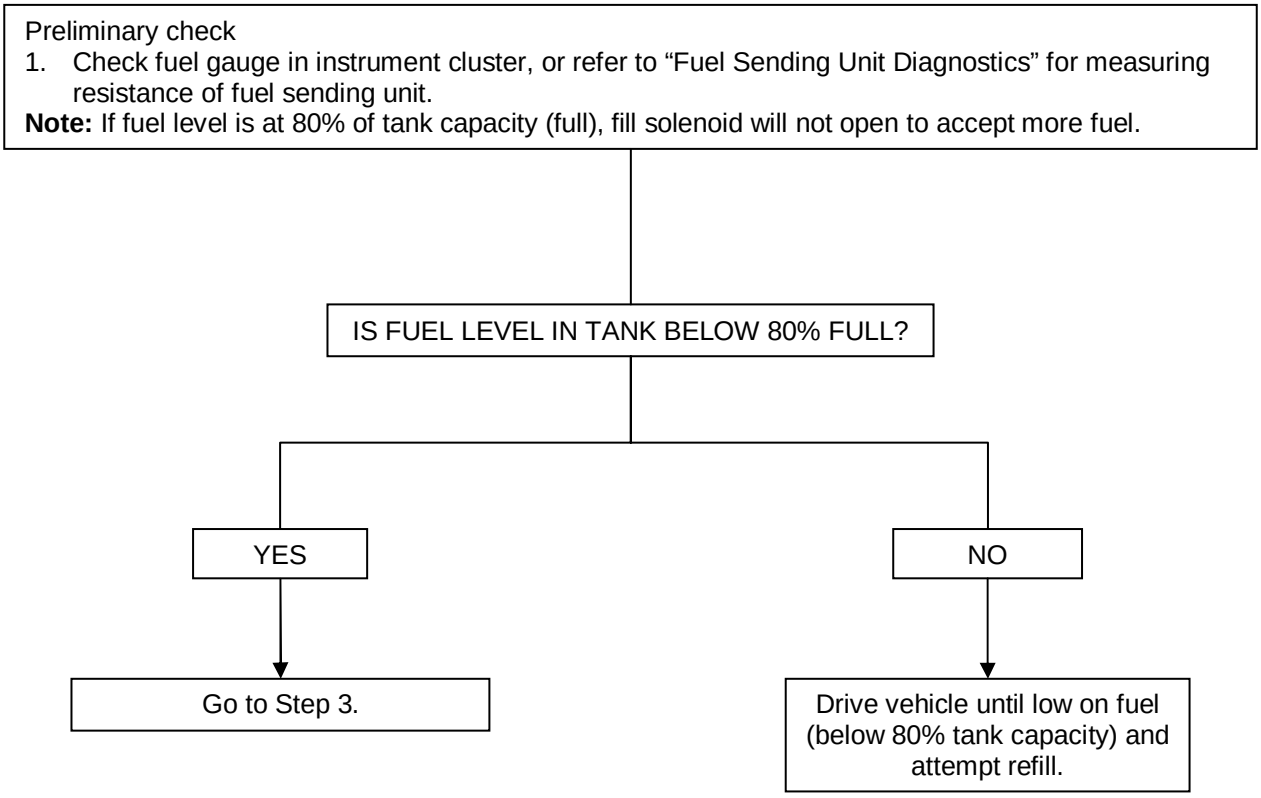
Diagnostic Flow Charts

No Fill Condition

1. VERIFY VEHICLE BATTERY IS FULLY CHARGED AND CONNECTED.

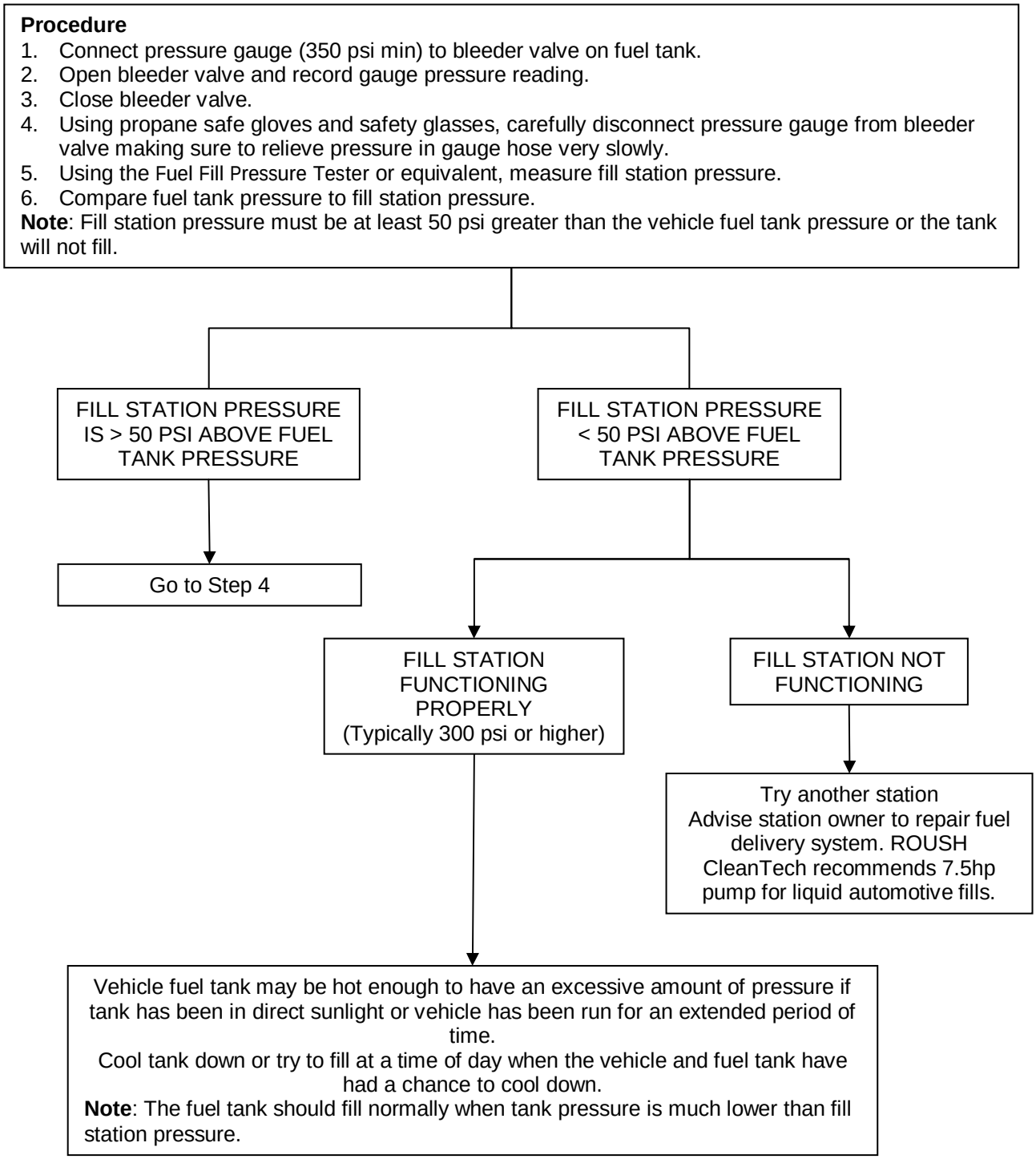


2. VERIFY THAT VEHICLE FUEL TANK IS ACTUALLY LOW ON FUEL AND NOT ALREADY FULL.


Preliminary check
1. Check fuel gauge in instrument cluster, or refer to “Fuel Sending Unit Diagnostics” for measuring resistance of fuel sending unit.
Note: If fuel level is at 80% of tank capacity (full), fill solenoid will not open to accept more fuel.
IS FUEL LEVEL IN TANK BELOW 80% FULL?
YES
NO
Go to Step 3.
Drive vehicle until low on fuel (below 80% tank capacity) and attempt refill.

Current as of 02/11/2011

3. VERIFY THAT STATION FILL HOSE IS PROPERLY CONNECTED TO VEHICLE AND STATION IS OPERATING.

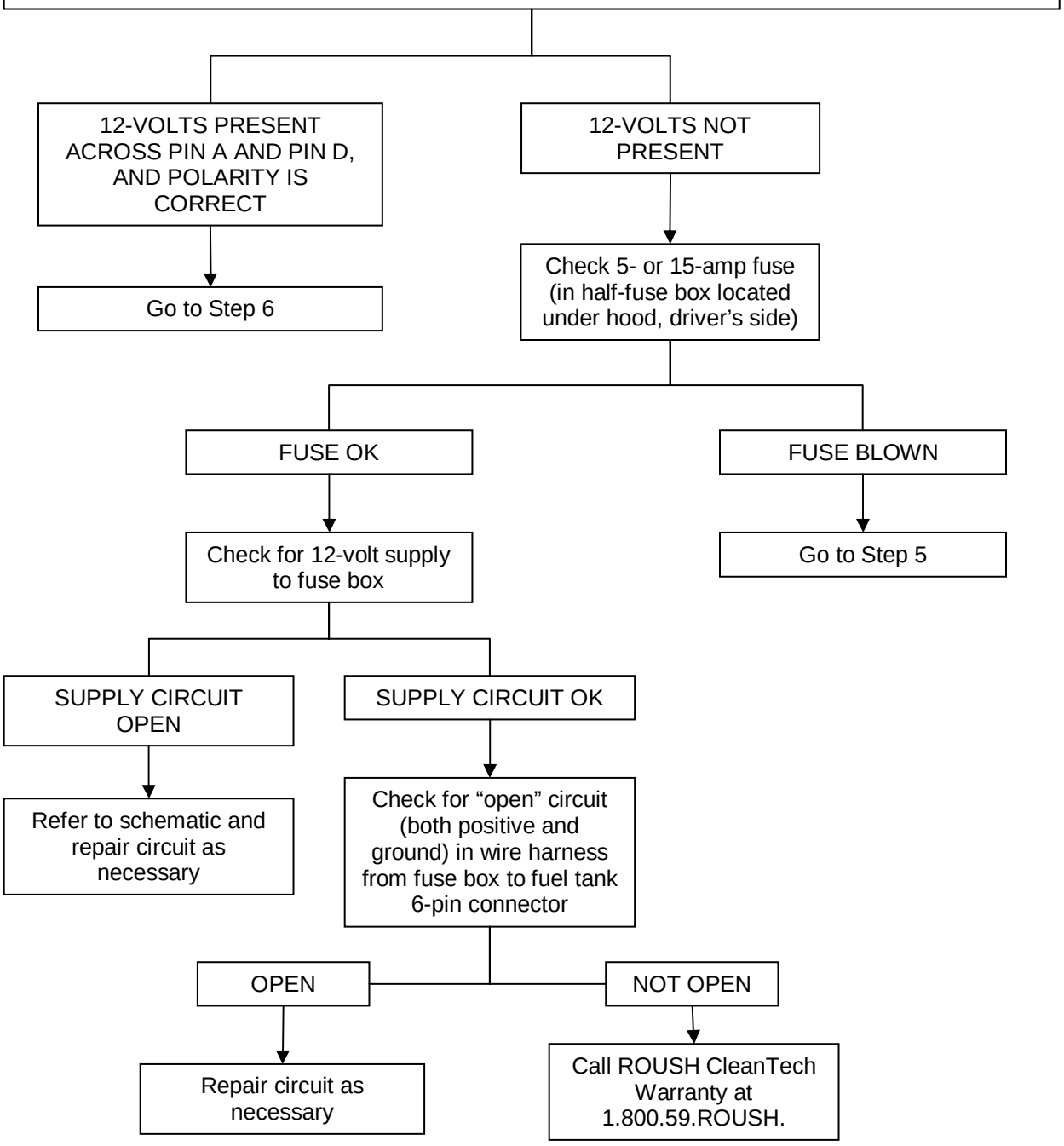

Procedure
1. Connect pressure gauge (350 psi min) to bleeder valve on fuel tank.
2. Open bleeder valve and record gauge pressure reading.
3. Close bleeder valve.
4. Using propane safe gloves and safety glasses, carefully disconnect pressure gauge from bleeder valve making sure to relieve pressure in gauge hose very slowly.
5. Using the Fuel Fill Pressure Tester or equivalent, measure fill station pressure.
6. Compare fuel tank pressure to fill station pressure.

Note: Fill station pressure must be at least 50 psi greater than the vehicle fuel tank pressure or the tank will not fill.
FILL STATION PRESSURE IS > 50 PSI ABOVE FUEL TANK PRESSURE
FILL STATION PRESSURE < 50 PSI ABOVE FUEL TANK PRESSURE
Go to Step 4
FILL STATION FUNCTIONING PROPERLY (Typically 300 psi or higher)
FILL STATION NOT FUNCTIONING
Try another station
Advise station owner to repair fuel delivery system. ROUSH CleanTech recommends 7.5hp pump for liquid automotive fills.
Vehicle fuel tank may be hot enough to have an excessive amount of pressure if tank has been in direct sunlight or vehicle has been run for an extended period of time.
Cool tank down or try to fill at a time of day when the vehicle and fuel tank have had a chance to cool down.
Note: The fuel tank should fill normally when tank pressure is much lower than fill station pressure.

Current as of 02/11/2011

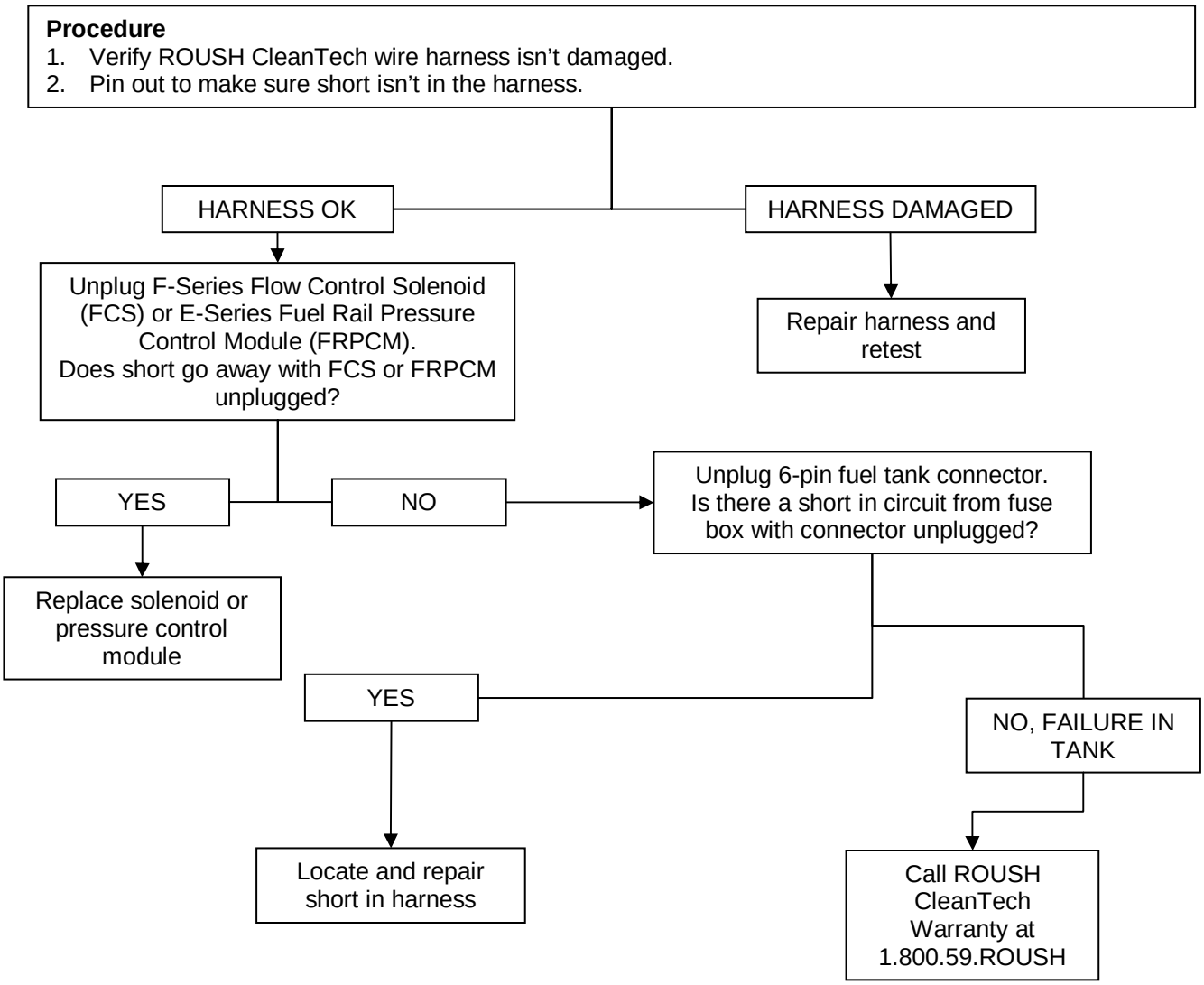
4. VERIFY THAT THERE IS 12-VOLT BATTERY POWER TO FUEL TANK FILL CIRCUIT AND POLARITY IS CORRECT.

Procedure
1. Turn the ignition switch to the off position if not already done.
2. Disconnect the 6-wire fuel tank harness connector (located on wire loom from fuel tank) from the vehicle harness.
3. Connect a voltmeter positive lead from the Blue wire (Pin A positive), and the negative lead to the plain Black wire (Pin D negative) on the vehicle side of the 6-wire connector or utilize the Fuel Tank Breakout Box (see guide provided with the breakout box).
4. Check the voltmeter reading. The voltmeter should indicate battery voltage (12 volts) and also indicate proper polarity.


12-VOLTS PRESENT ACROSS PIN A AND PIN D, AND POLARITY IS CORRECT
Go to Step 6
12-VOLTS NOT PRESENT
Check 5- or 15-amp fuse (in half-fuse box located under hood, driver's side)
FUSE OK
Check for 12-volt supply to fuse box
SUPPLY CIRCUIT OPEN
Refer to schematic and repair circuit as necessary
SUPPLY CIRCUIT OK
Check for "open" circuit (both positive and ground) in wire harness from fuse box to fuel tank 6-pin connector
OPEN
Repair circuit as necessary
NOT OPEN
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH.
FUSE BLOWN
Go to Step 5

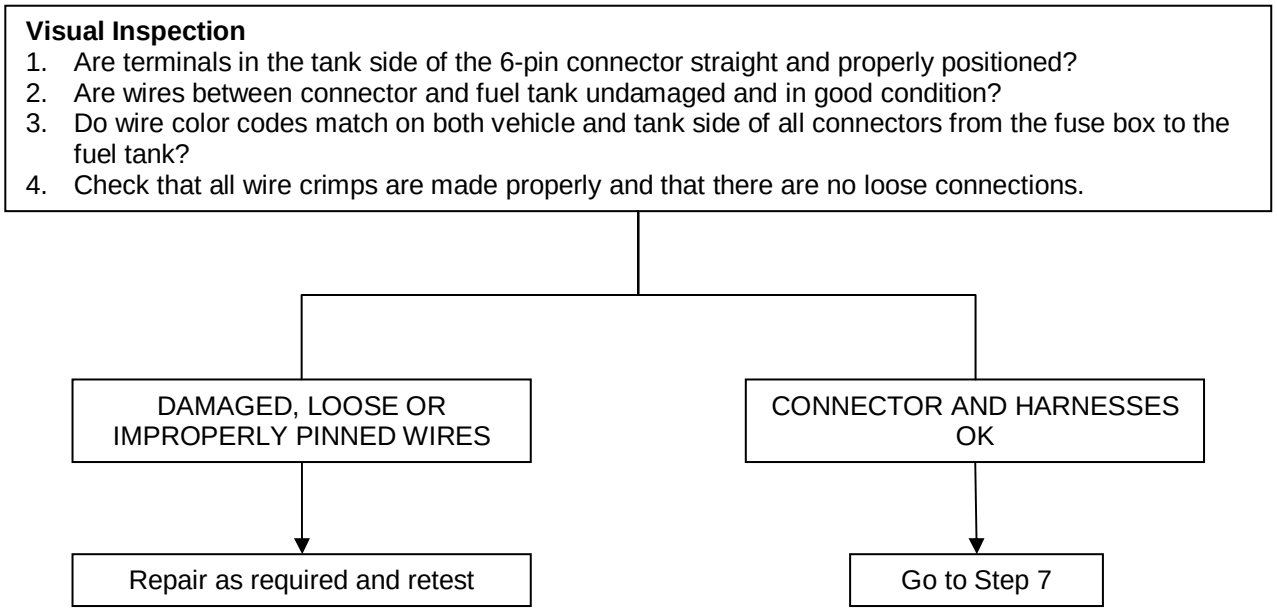
Current as of 02/11/2011

5. CHECK FOR SHORT CIRCUIT IN 12-VOLT SUPPLY TO FUSE BOX.

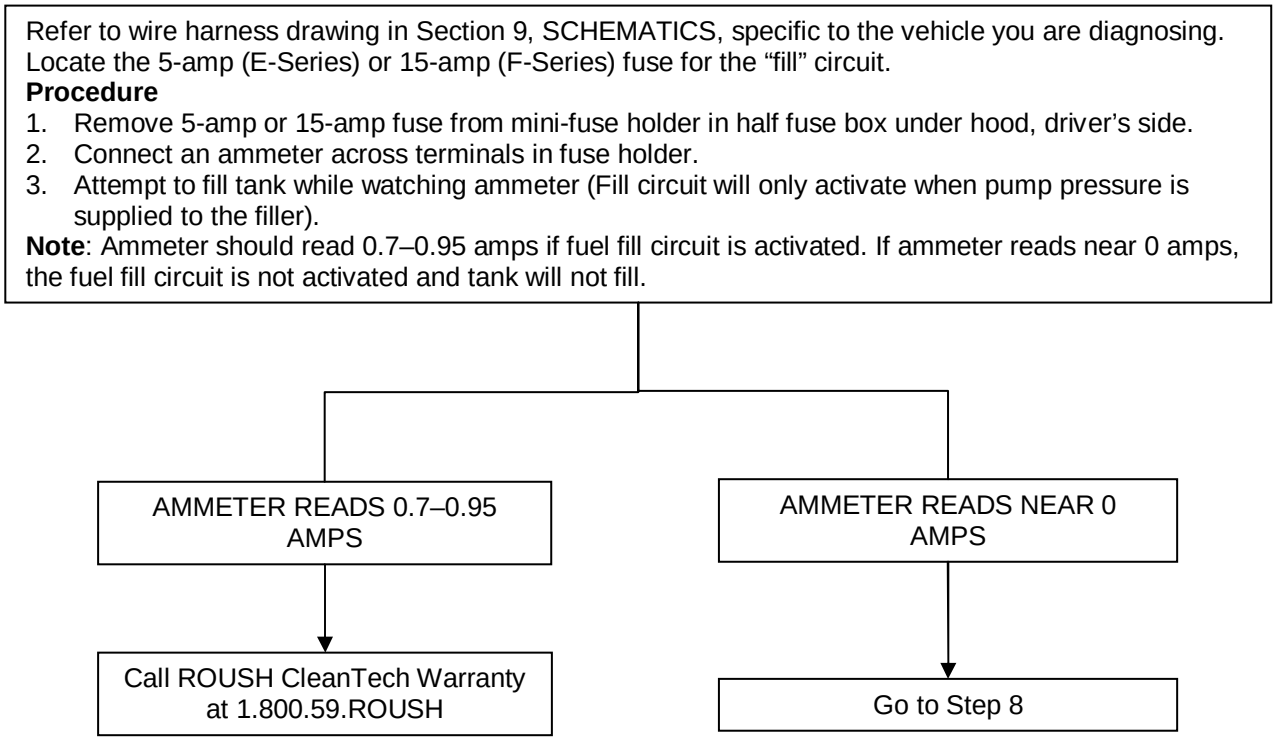

Procedure
1. Verify ROUSH CleanTech wire harness isn't damaged.
2. Pin out to make sure short isn't in the harness.
HARNESS OK
HARNESS DAMAGED
Unplug F-Series Flow Control Solenoid (FCS) or E-Series Fuel Rail Pressure Control Module (FRPCM). Does short go away with FCS or FRPCM unplugged?
Repair harness and retest
YES
NO
Unplug 6-pin fuel tank connector. Is there a short in circuit from fuse box with connector unplugged?
Replace solenoid or pressure control module
YES
NO, FAILURE IN TANK
Locate and repair short in harness
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH

Current as of 02/11/2011

6. VERIFY THAT THE 6-PIN FUEL TANK CONNECTOR AND HARNESSES TO THE FUEL TANK ARE UNDAMAGED AND OK.


Visual Inspection
1. Are terminals in the tank side of the 6-pin connector straight and properly positioned?
2. Are wires between connector and fuel tank undamaged and in good condition?
3. Do wire color codes match on both vehicle and tank side of all connectors from the fuse box to the fuel tank?
4. Check that all wire crimps are made properly and that there are no loose connections.
DAMAGED, LOOSE OR IMPROPERLY PINNED WIRES
CONNECTOR AND HARNESSES OK
Repair as required and retest
Go to Step 7

7. RECONNECT 6-PIN CONNECTOR AND MEASURE CURRENT TO TANK FILL CIRCUIT.

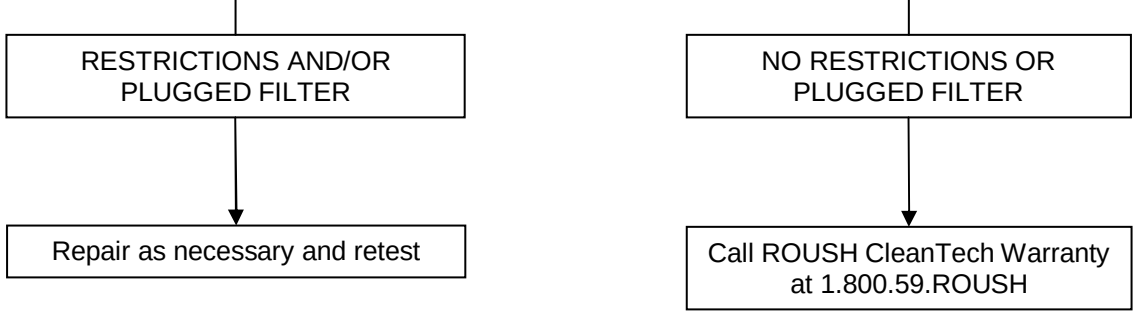

Refer to wire harness drawing in Section 9, SCHEMATICS, specific to the vehicle you are diagnosing. Locate the 5-amp (E-Series) or 15-amp (F-Series) fuse for the "fill" circuit.
Procedure
1. Remove 5-amp or 15-amp fuse from mini-fuse holder in half fuse box under hood, driver's side.
2. Connect an ammeter across terminals in fuse holder.
3. Attempt to fill tank while watching ammeter (Fill circuit will only activate when pump pressure is supplied to the filler).
Note: Ammeter should read 0.7–0.95 amps if fuel fill circuit is activated. If ammeter reads near 0 amps, the fuel fill circuit is not activated and tank will not fill.
AMMETER READS 0.7–0.95 AMPS
AMMETER READS NEAR 0 AMPS
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH
Go to Step 8

Current as of 02/11/2011

8. CHECK FOR RESTRICTIONS IN THE FUEL FILL SYSTEM.

Procedure
1. Check for kinks or restrictions in the tank blue fill hose.
2. Verify that the fuel filter is not plugged.
3. Verify that the Fill Valve is functioning properly.

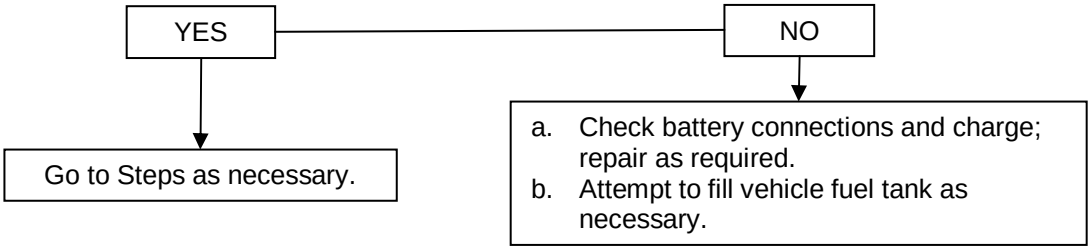
Note: If any of the above problem conditions exist, the fuel fill switch will not close and will prevent the tank from filling.


RESTRICTIONS AND/OR PLUGGED FILTER
NO RESTRICTIONS OR PLUGGED FILTER
Repair as necessary and retest
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH

Current as of 02/11/2011

Slow Fill Condition

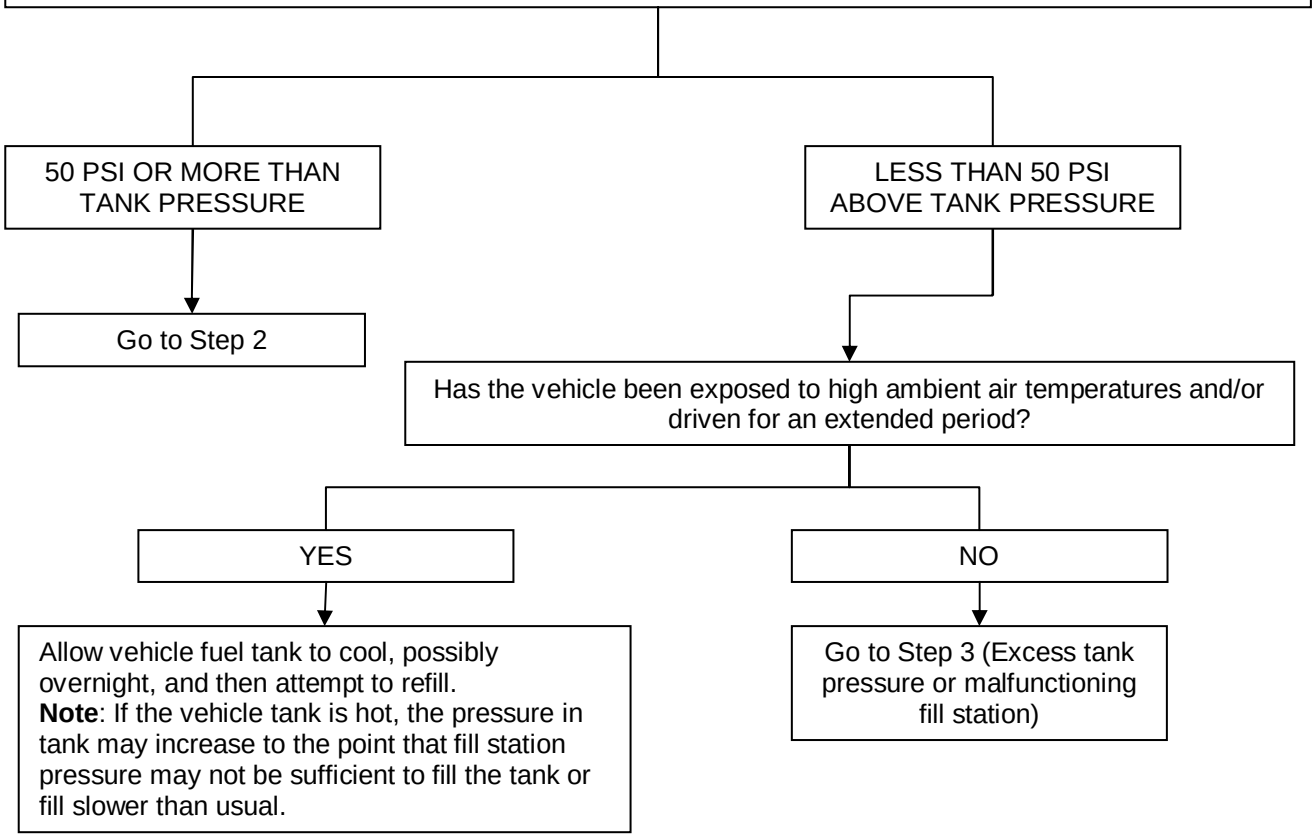
1. VERIFY VEHICLE BATTERY IS FULLY CHARGED AND CONNECTED.


YES
NO
Go to Steps as necessary.
a. Check battery connections and charge; repair as required.
b. Attempt to fill vehicle fuel tank as necessary.

2. VERIFY THAT FILL STATION PRESSURE IS AT LEAST 50 PSI GREATER THAN VEHICLE TANK PRESSURE.

Preliminary check
If this is the first fill after vehicle assembly or major fuel system repair, follow ROUSH CleanTech service "Flush and Fill Procedure for New Tank".
Note: If fill is EXTREMELY slow (less than 0.2 gallons per minute) and fill station pressure is acceptable (>50 PSI over tank), it may indicate that the fill circuit is not activated. Follow "No-Fill Condition" diagnostic.
Procedure
1. Attach pressure gauge (350 psi minimum) to bleeder valve on vehicle fuel tank.
2. Compare tank pressure reading to fill station pressure.
3. Record vehicle tank and fill station pressure readings for reference.

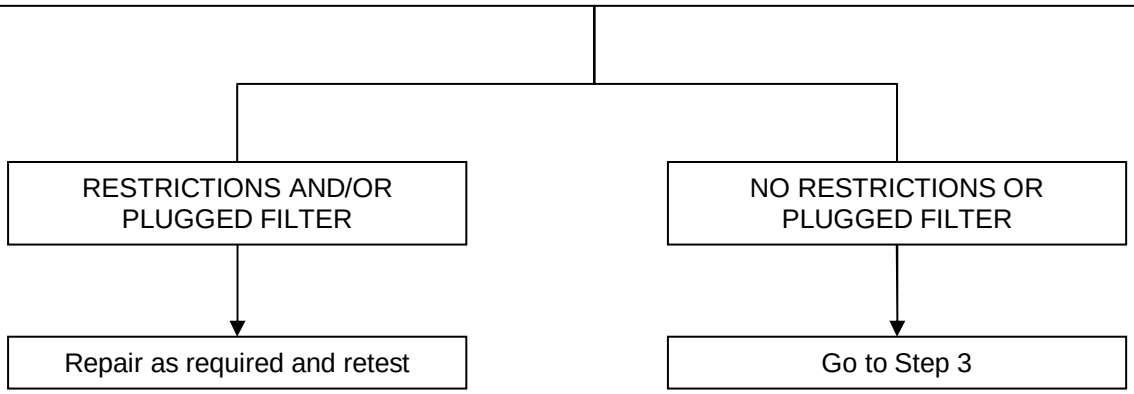
Note: Fill station pressure must be at least 50 psi greater than tank pressure. If not, fuel tank may not fill or will fill slowly.


50 PSI OR MORE THAN TANK PRESSURE
LESS THAN 50 PSI ABOVE TANK PRESSURE
Go to Step 2
Has the vehicle been exposed to high ambient air temperatures and/or driven for an extended period?
YES
NO
Allow vehicle fuel tank to cool, possibly overnight, and then attempt to refill.
Note: If the vehicle tank is hot, the pressure in tank may increase to the point that fill station pressure may not be sufficient to fill the tank or fill slower than usual.
Go to Step 3 (Excess tank pressure or malfunctioning fill station)

Current as of 02/11/2011

3. CHECK FOR RESTRICTIONS IN THE FUEL FILL SYSTEM.

Procedure
1. Check for kinks or restriction in the tank blue fill hose.
2. Verify that the fuel filter is not plugged.
3. Verify that the Fill Valve is functioning properly.

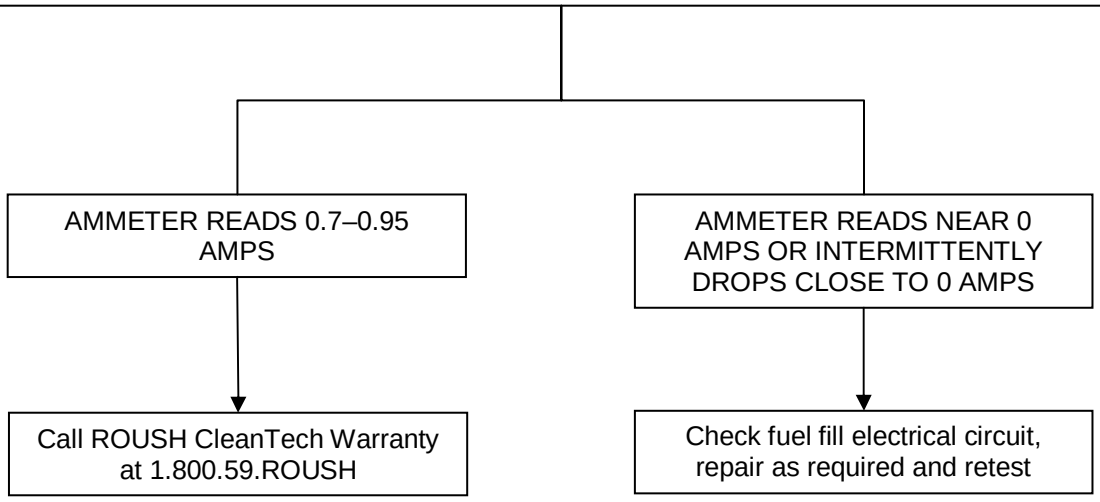


4. CHECK CURRENT FLOW TO THE TANK FILL CIRCUIT

Refer to wire harness drawing in Section 9, SCHEMATICS, specific to the vehicle you are diagnosing. Locate the 5-amp (E-Series) or 15-amp (F-Series) fuse for the "fill" circuit.

Procedure
1. Remove 5-amp or 15-amp fuse from mini-fuse holder in half fuse box under hood, driver's side.
2. Connect an ammeter across terminals in fuse holder.
3. Attempt to fill tank while watching ammeter.

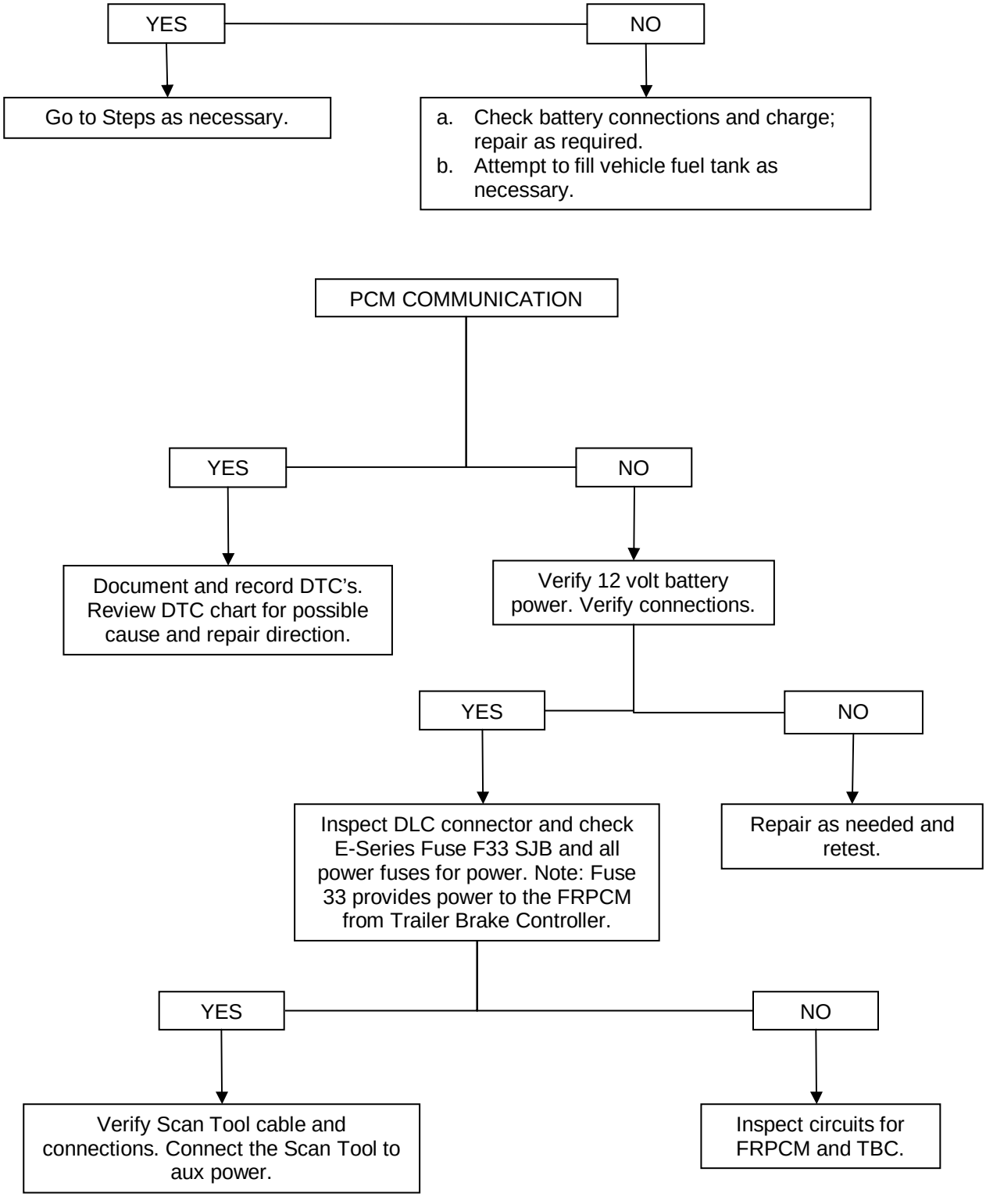
Note: Ammeter should read 0.7–0.95 amps if fuel fill circuit is activated. If ammeter reads near 0 amps, the fuel fill circuit is not activated and tank will not fill.


AMMETER READS 0.7–0.95 AMPS
AMMETER READS NEAR 0 AMPS OR INTERMITTENTLY DROPS CLOSE TO 0 AMPS
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH
Check fuel fill electrical circuit, repair as required and retest

Current as of 02/11/2011

No Start Condition

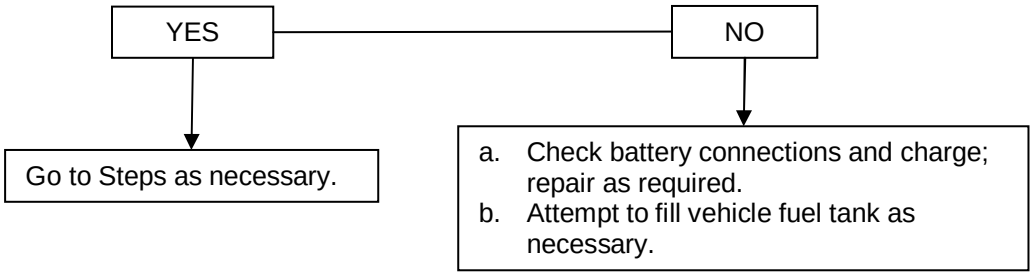
1. VERIFY VEHICLE BATTERY IS FULLY CHARGED AND CONNECTED.


YES
NO
Go to Steps as necessary.
a. Check battery connections and charge; repair as required.
b. Attempt to fill vehicle fuel tank as necessary.
PCM COMMUNICATION
YES
NO
Document and record DTC's. Review DTC chart for possible cause and repair direction.
Verify 12 volt battery power. Verify connections.
YES
NO
Inspect DLC connector and check E-Series Fuse F33 SJB and all power fuses for power. Note: Fuse 33 provides power to the FRPCM from Trailer Brake Controller.
Repair as needed and retest.
YES
NO
Verify Scan Tool cable and connections. Connect the Scan Tool to aux power.
Inspect circuits for FRPCM and TBC.

Current as of 02/11/2011

Fuel Pump Diagnostics

1. VERIFY VEHICLE BATTERY IS FULLY CHARGED AND CONNECTED.

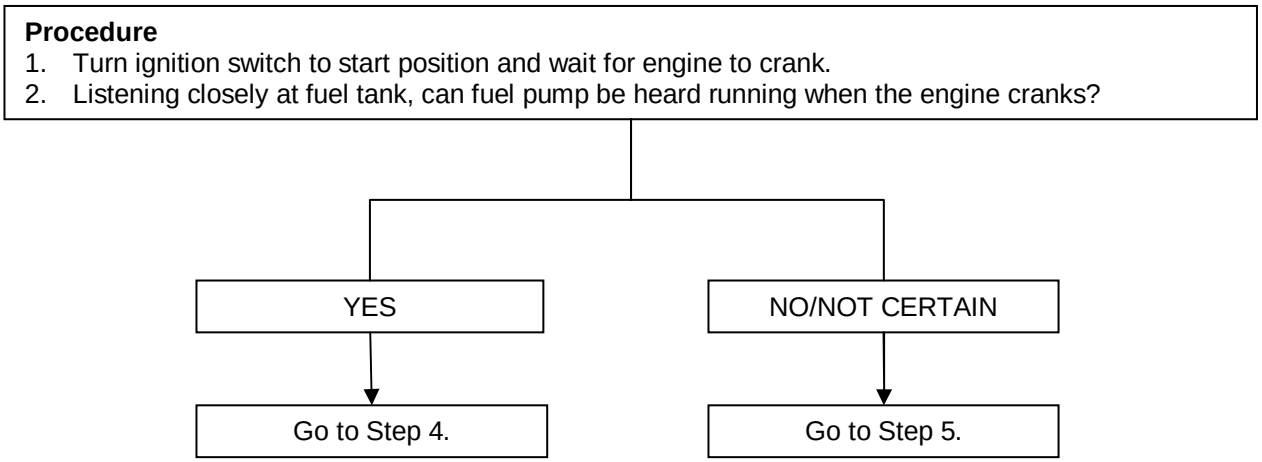

YES
NO
Go to Steps as necessary.
a. Check battery connections and charge; repair as required.
b. Attempt to fill vehicle fuel tank as necessary.

2. GENERAL INFORMATION

The fuel pump should run continuously when the engine is cranking or running. The ROUSH CleanTech fuel pump relay in the mini relay box is controlled by the original Ford fuel pump circuitry including the Fuel Pump Driver Module and the Inertia Switch or Fuel Pump Interrupt software. It is virtually the same as the production Ford circuit except for the addition of a separate fuel pump relay, fuel pump fuse and ROUSH CleanTech wire harness to the fuel pump.

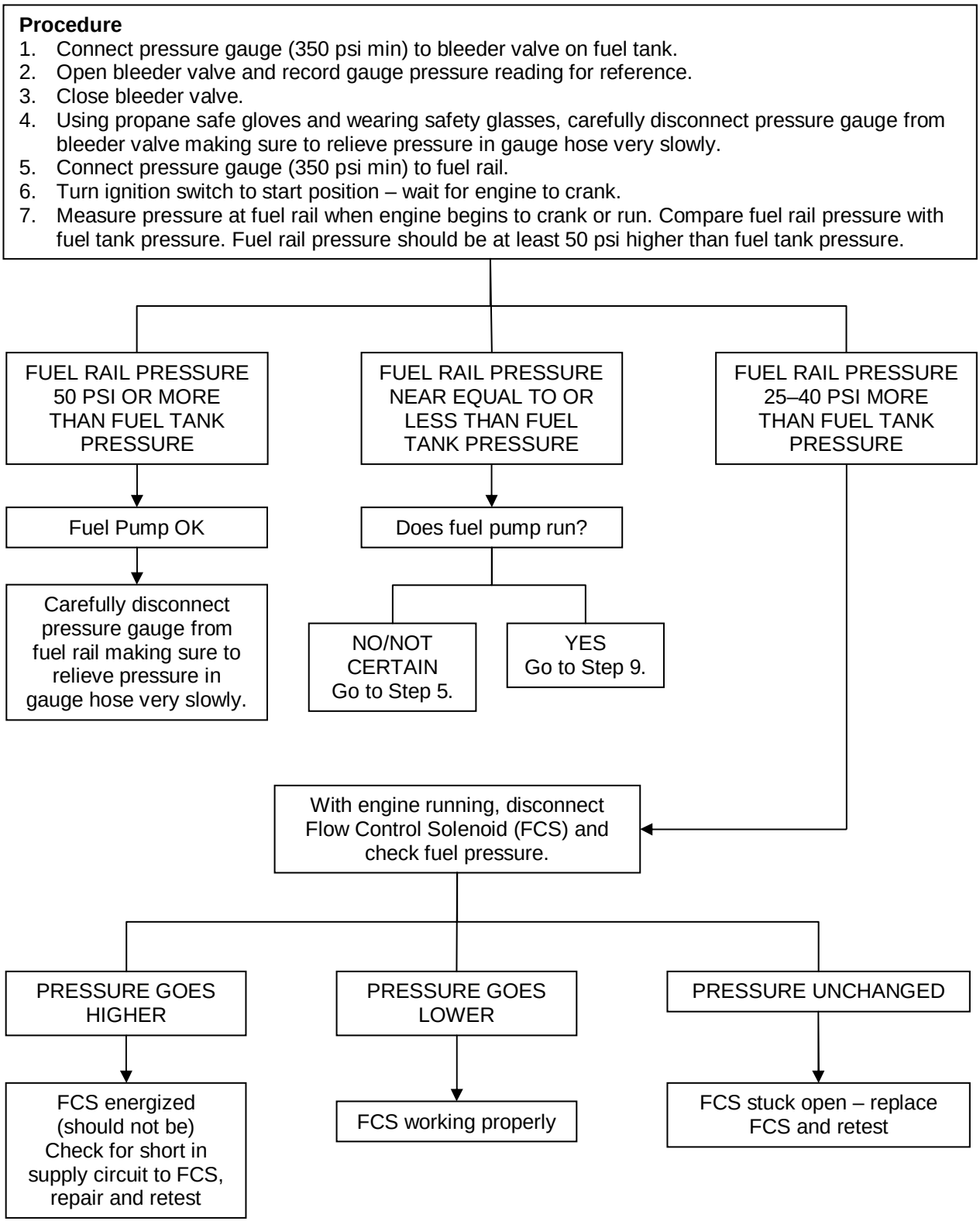
To verify that the fuel pump is operating properly, use the following procedure starting with Step 3.

3. CHECK FUEL PUMP OPERATION


Procedure
1. Turn ignition switch to start position and wait for engine to crank.
2. Listening closely at fuel tank, can fuel pump be heard running when the engine cranks?
YES
NO/NOT CERTAIN
Go to Step 4.
Go to Step 5.

Current as of 02/11/2011

4. CHECK FUEL PUMP PRESSURE


Procedure
1. Connect pressure gauge (350 psi min) to bleeder valve on fuel tank.
2. Open bleeder valve and record gauge pressure reading for reference.
3. Close bleeder valve.
4. Using propane safe gloves and wearing safety glasses, carefully disconnect pressure gauge from bleeder valve making sure to relieve pressure in gauge hose very slowly.
5. Connect pressure gauge (350 psi min) to fuel rail.
6. Turn ignition switch to start position – wait for engine to crank.
7. Measure pressure at fuel rail when engine begins to crank or run. Compare fuel rail pressure with fuel tank pressure. Fuel rail pressure should be at least 50 psi higher than fuel tank pressure.
FUEL RAIL PRESSURE 50 PSI OR MORE THAN FUEL TANK PRESSURE
FUEL RAIL PRESSURE NEAR EQUAL TO OR LESS THAN FUEL TANK PRESSURE
FUEL RAIL PRESSURE 25–40 PSI MORE THAN FUEL TANK PRESSURE
Fuel Pump OK
Does fuel pump run?
Carefully disconnect pressure gauge from fuel rail making sure to relieve pressure in gauge hose very slowly.
NO/NOT CERTAIN Go to Step 5.
YES Go to Step 9.
With engine running, disconnect Flow Control Solenoid (FCS) and check fuel pressure.
PRESSURE GOES HIGHER
PRESSURE GOES LOWER
PRESSURE UNCHANGED
FCS energized (should not be) Check for short in supply circuit to FCS, repair and retest
FCS working properly
FCS stuck open – replace FCS and retest

Current as of 02/11/2011

5. CHECK MULTIVALVE SOLENOID ACTUATION

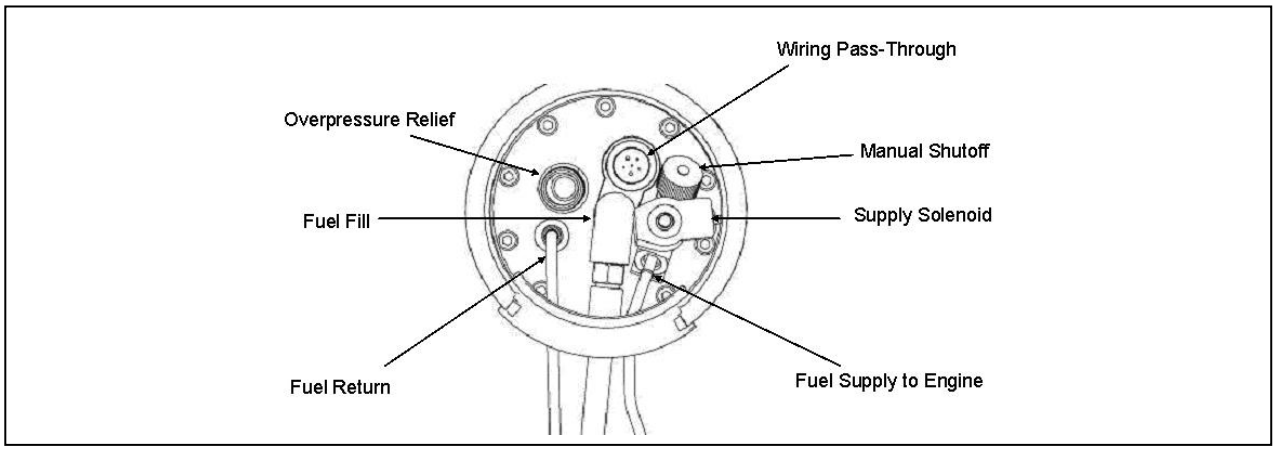
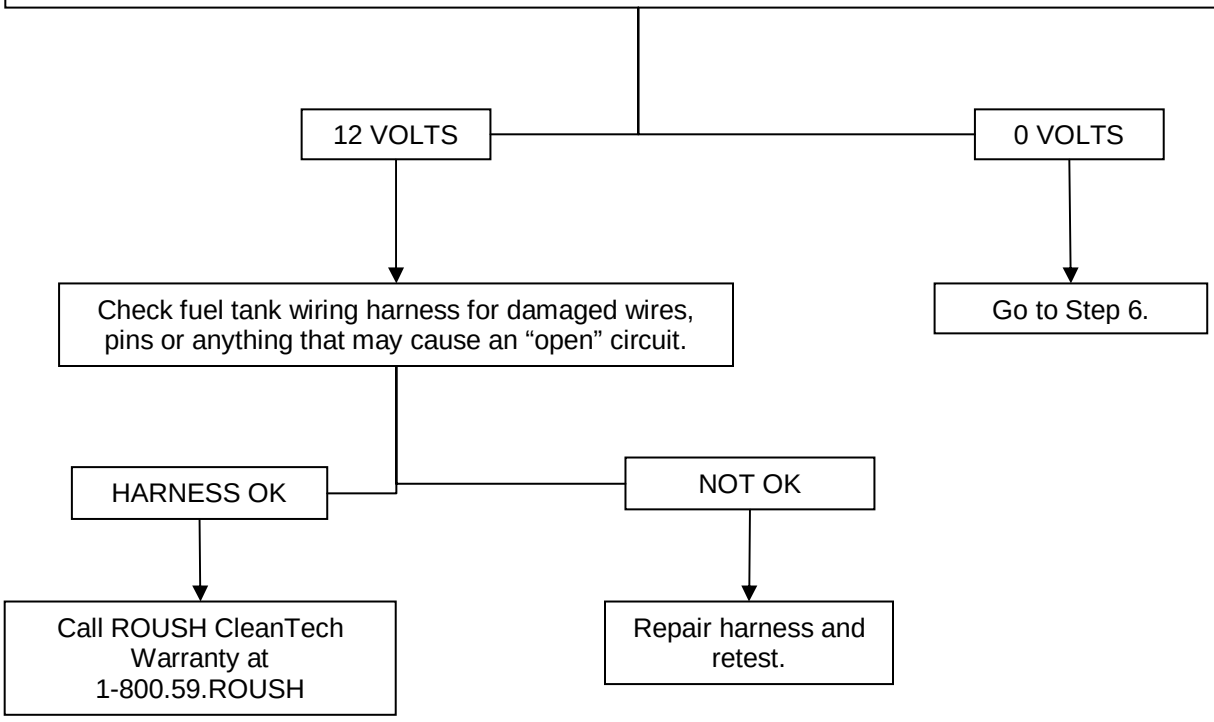


Figure 13 — Multivalve

Procedure

1. Turn ignition switch to off position if not already done.
2. Disconnect 6-pin fuel tank harness connector (located on wire loom at fuel tank) from vehicle harness.
3. Connect positive lead of voltmeter to the Pink/Black wire (Pin xx), and negative lead to the Brown/White wire (Pin xx) on vehicle side of harness connector.
4. Turn ignition switch to start position, release and wait for engine to crank.
5. Check voltmeter reading when engine begins to crank. Voltmeter should indicate battery voltage (12 volts) across the two wires.


12 VOLTS
0 VOLTS
Check fuel tank wiring harness for damaged wires, pins or anything that may cause an “open” circuit.
Go to Step 6.
HARNESS OK
NOT OK
Call ROUSH CleanTech Warranty at 1-800.59.ROUSH
Repair harness and retest.

Current as of 02/11/2011

6. CHECK 20-AMP FUSE

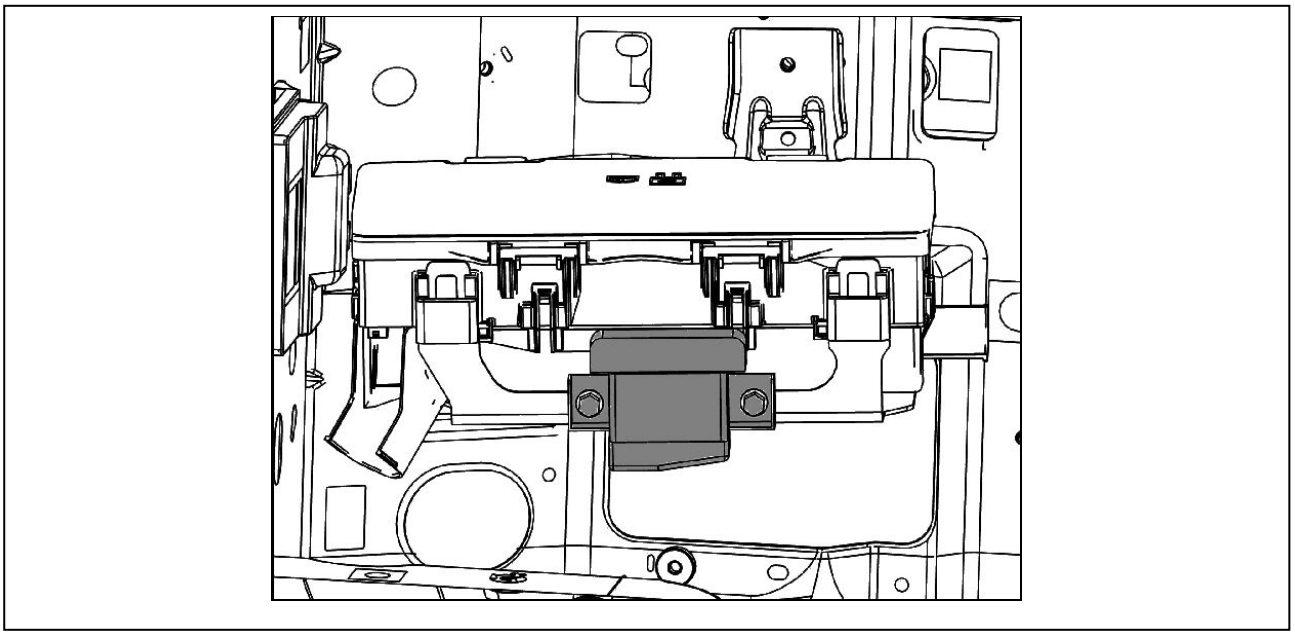
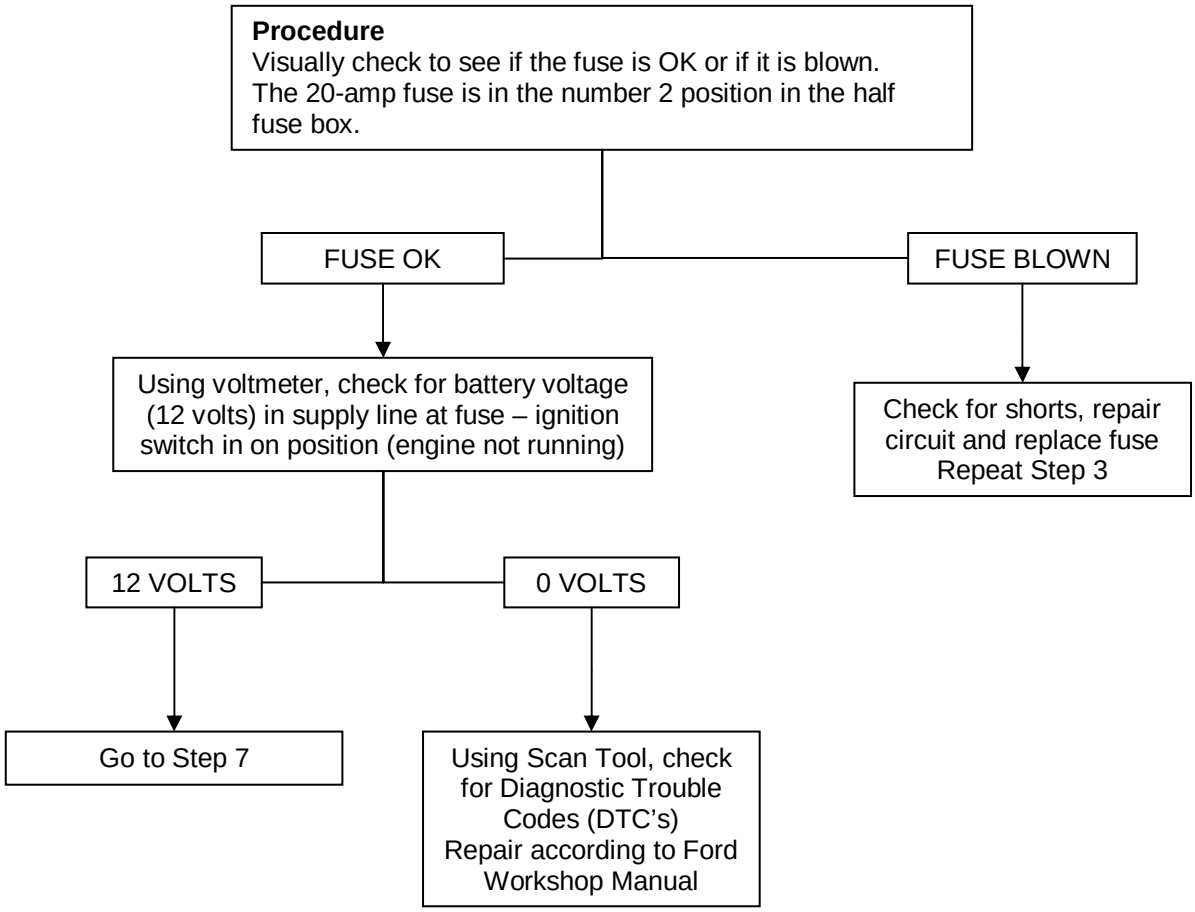


Figure 14 — Half-Fuse Box


Procedure
Visually check to see if the fuse is OK or if it is blown. The 20-amp fuse is in the number 2 position in the half fuse box.
FUSE OK
FUSE BLOWN
Using voltmeter, check for battery voltage (12 volts) in supply line at fuse – ignition switch in on position (engine not running)
Check for shorts, repair circuit and replace fuse
Repeat Step 3
12 VOLTS
0 VOLTS
Go to Step 7
Using Scan Tool, check for Diagnostic Trouble Codes (DTC's)
Repair according to Ford Workshop Manual

Current as of 02/11/2011

7. CHECK FUEL PUMP RELAY FUNCTION

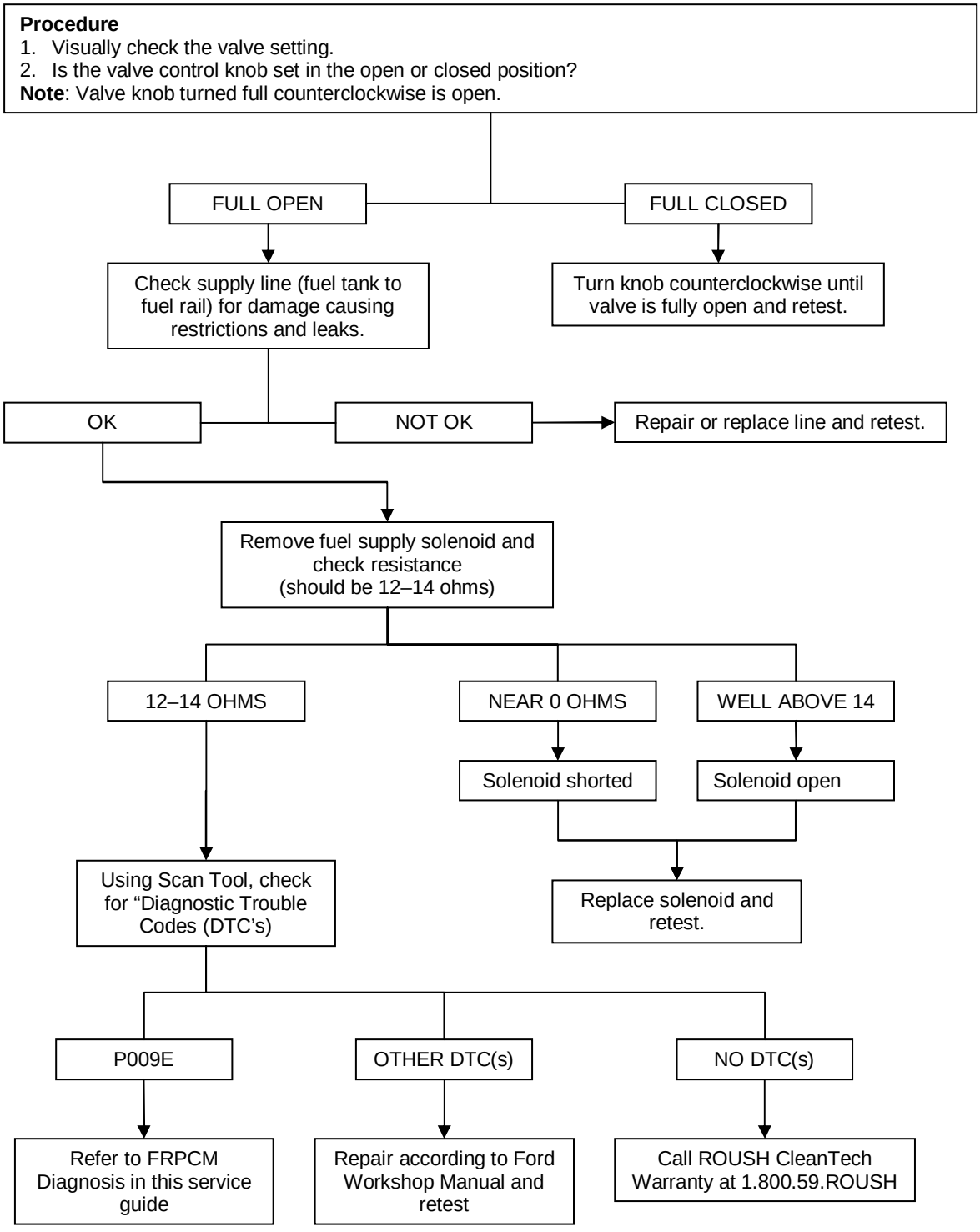
   Check fuel pump relay function per the Ford On-line Workshop Manual and wiring diagrams.

8. CHECK FUEL PUMP RELAY SUPPLY CIRCUIT

   Check fuel pump relay function per the Ford On-line Workshop Manual and wiring diagrams.

Current as of 02/11/2011

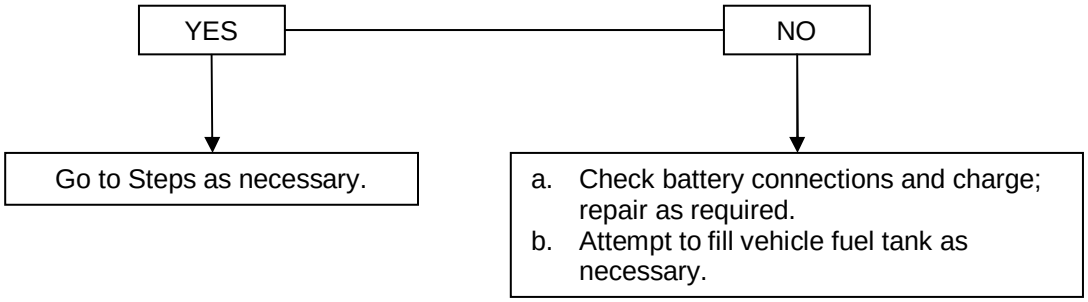
9. CHECK MANUAL VALVE OPERATION


Procedure
1. Visually check the valve setting.
2. Is the valve control knob set in the open or closed position?
Note: Valve knob turned full counterclockwise is open.
FULL OPEN
FULL CLOSED
Check supply line (fuel tank to fuel rail) for damage causing restrictions and leaks.
Turn knob counterclockwise until valve is fully open and retest.
OK
NOT OK
Repair or replace line and retest.
Remove fuel supply solenoid and check resistance (should be 12–14 ohms)
12–14 OHMS
NEAR 0 OHMS
WELL ABOVE 14
Solenoid shorted
Solenoid open
Using Scan Tool, check for "Diagnostic Trouble Codes (DTC's)
Replace solenoid and retest.
P009E
OTHER DTC(s)
NO DTC(s)
Refer to FRPCM Diagnosis in this service guide
Repair according to Ford Workshop Manual and retest
Call ROUSH CleanTech Warranty at 1.800.59.ROUSH

Current as of 02/11/2011

Fuel Sending Unit Diagnostics

1. VERIFY VEHICLE BATTERY IS FULLY CHARGED AND CONNECTED.


YES
NO
Go to Steps as necessary.
a. Check battery connections and charge; repair as required.
b. Attempt to fill vehicle fuel tank as necessary.

2. VOLT POWER TO FUEL SENDING UNIT.

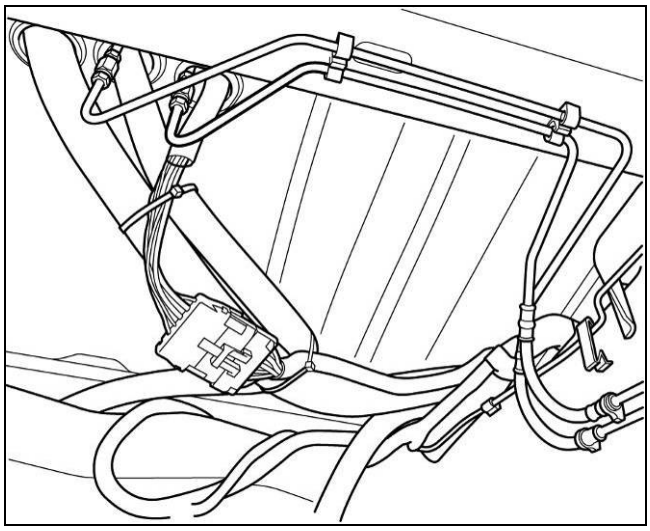
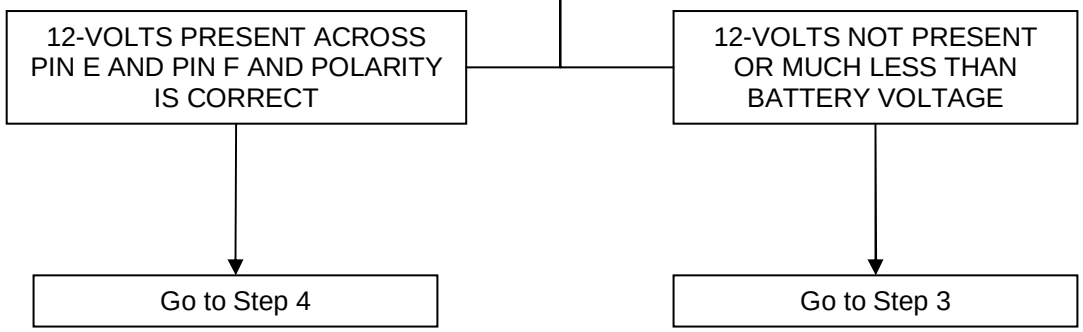


Figure 15 — 6-Pin Harness Connector (Vehicle Side)

Current as of 02/11/2011

Procedure

1. Turn the ignition switch to the off position if not already done.
2. Disconnect the 6-pin fuel tank harness connector (located on fuel tank wire loom) from the vehicle harness.
3. On the vehicle side of the 6-pin connector, connect positive lead of voltmeter to the Yellow wire (Pin E positive), and negative lead to the Black/Orange wire (Pin F negative).
4. Check the voltmeter reading. The voltmeter should indicate battery voltage (12 volts) and also indicate proper polarity.


12-VOLTS PRESENT ACROSS PIN E AND PIN F AND POLARITY IS CORRECT
12-VOLTS NOT PRESENT OR MUCH LESS THAN BATTERY VOLTAGE
Go to Step 4
Go to Step 3

Current as of 02/11/2011

3. CHECK FOR 12-VOLT POWER AT THE 4-PIN CONNECTOR.

Figure 16 — ROUSH-to-Ford 4-Pin Harness Connector (Typical)

Procedure

1. With the ignition switch in the off position, disconnect the 4-pin connector where the ROUSH CleanTech harness attaches to the Ford vehicle harness.
2. Using the voltmeter on the Ford harness side of the connector, place the positive lead on the Yellow wire terminal and the negative lead on the Black/Orange wire terminal.
3. Check for battery voltage (12 volts) across the terminals.

12-VOLTS PRESENT ACROSS YELLOW AND BLACK/ORANGE WIRES, AND POLARITY IS CORRECT

→ Repair open circuit in ROUSH CleanTech harness from 4-pin connector to 6-pin connector

12-VOLTS NOT PRESENT OR MUCH LESS THAN BATTERY VOLTAGE

→ Refer to the Ford Workshop Manual to determine fault

Current as of 02/11/2011

4. CHECK RESISTANCE ACROSS TERMINALS OF FUEL SENDING UNIT

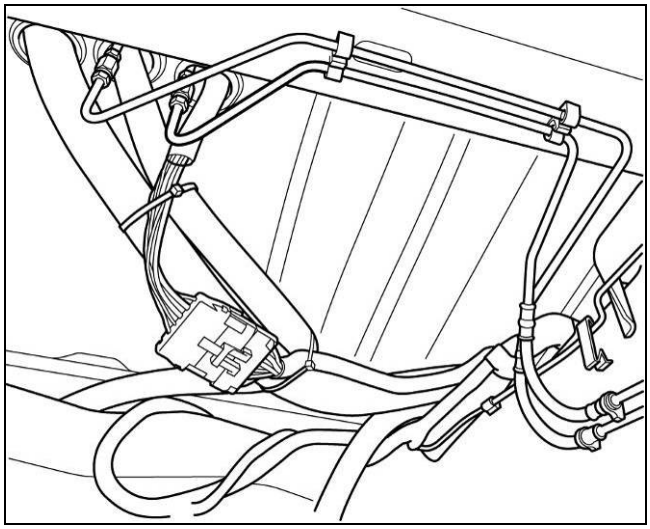


Figure 17 — Fuel Sending Unit 6-Pin Connector Terminals

Procedure
1. Place positive probe of ohmmeter on Yellow wire (Pin E) and negative probe on Black/Orange wire (Pin F).
2. Measure resistance across the terminals and check resistance reading against the Fuel Fill Table below for fuel level in vehicle being tested.

Note: The measured resistance should indicate the amount of fuel in the tank.

Fuel Fill Table

Model, Tank Configuration	Resistance (ohms)				
	Full	**3/4**	**1/2**	**1/4**	**Empty**
E-150/E-250/E-350, Under Vehicle	15	30	55	90	160

Current as of 02/11/2011

MAINTENANCE REQUIREMENTS

Schedule

With the exception of the fuel system, follow the Ford Maintenance Schedules and Workshop Manual for all E-Series and F-Series maintenance requirements.

For the ROUSH CleanTech LPI fuel system, refer to the schedule and procedures below.

Operation	Maintenance Interval
In-line Fuel Filter Replacement	50,000 miles (80,000 km)

MAINTENANCE PROCEDURES

Intake Air Filter Inspection

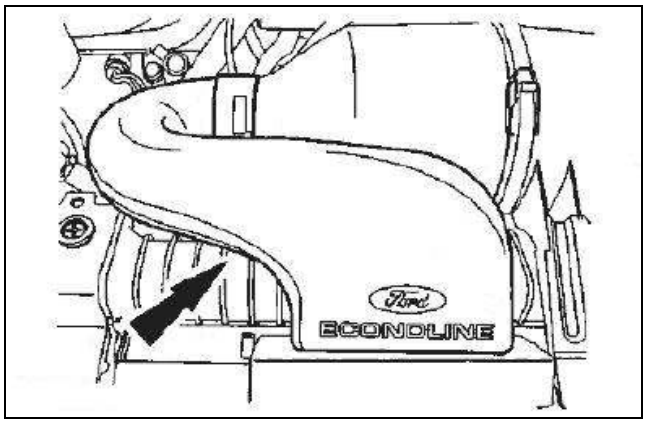


Figure 18 — Intake Air Duct and Filter Housing (typical)

This intake air filter assembly is common to base Ford vehicles. Consult the appropriate Ford Work Shop Manual for service.

Current as of 02/11/2011

In-Line Fuel Filter Replacement

⚠ **Danger** — A trace amount of propane fuel will be released on loosening the fittings. It will settle to the lowest available surface before it dissipates into the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

1. Purge residual fuel from the fuel fill line.
2. Disconnect the fuel fill line from the fuel filter inlet.

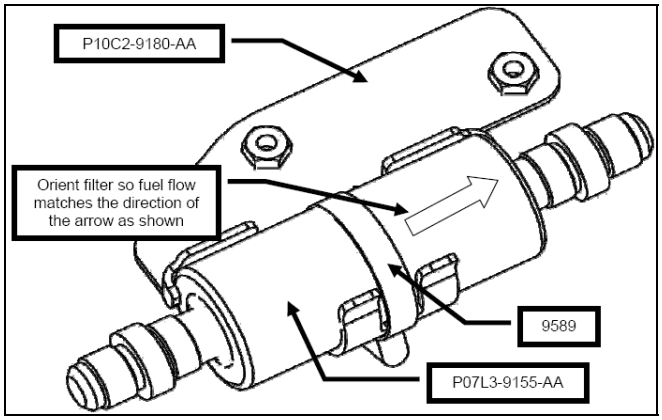


Figure 19 — In-Line Fuel Filter (Typical)

3. Disconnect the fuel fill line from the fuel filter outlet.
4. Loosen the clamp retaining the fuel filter in place.
5. Remove and discard the filter.
6. Place a new fuel filter in position on the filter bracket and tighten the retaining clamp to 4–5 N•m (35–44 lb-in).
7. Connect the fuel file lines to the filter inlet and outlet. Tighten the line fittings to 41–49 N•m (30–36 lb-ft).

Current as of 02/11/2011

REPAIR PROCEDURES

Preparing Vehicle for Service

Alert Messages

The following alert messages appear from time to time in appropriate places in this manual. Ensure that all personnel in the immediate area are aware of these reminders.

⚠ **Danger** — Propane is nontoxic, nonpoisonous, has the lowest flammability range of any alternative fuel and dissipates quickly when released into the atmosphere. Propane vapor is heavier than air and seeks the lowest point. When the ratio of propane to air is between 2.2% and 9.6%, propane burns in the presence of an ignition source at 940°F (504°C)[1] or hotter. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Failure to heed this danger can result in severe personal injury.

⚠ **Danger** — Fuel supply lines remain pressurized after engine shutdown. Keep away from heat, sparks, flames, static electricity or other sources of ignition. Do NOT enter storage areas or confined spaces unless they are adequately ventilated. Failure to heed this danger can result in severe personal injury.

⚠ **Danger** — Propane is heavier than air and seeks the lowest available level when released to the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

⚠ **Warning** — Liquid propane is cold. The temperature of propane in its liquid state is -44°F (-42°C). Wear eye and ear protection during venting and repair operations. Keep moisture away from the valves. Failure to heed this warning can result in personal injury.

Note — Identify the condition (good, stuck open, stuck closed or inoperable) of each solenoid valve prior to venting the fuel tank to ensure that the solenoid valves are not the reason for vehicle service and unnecessarily venting the tank.

[1] Gasoline auto-ignition occurs at a much lower temperature: 430°–500°F (221°–260°C).

Current as of 02/11/2011

Changing Fuses

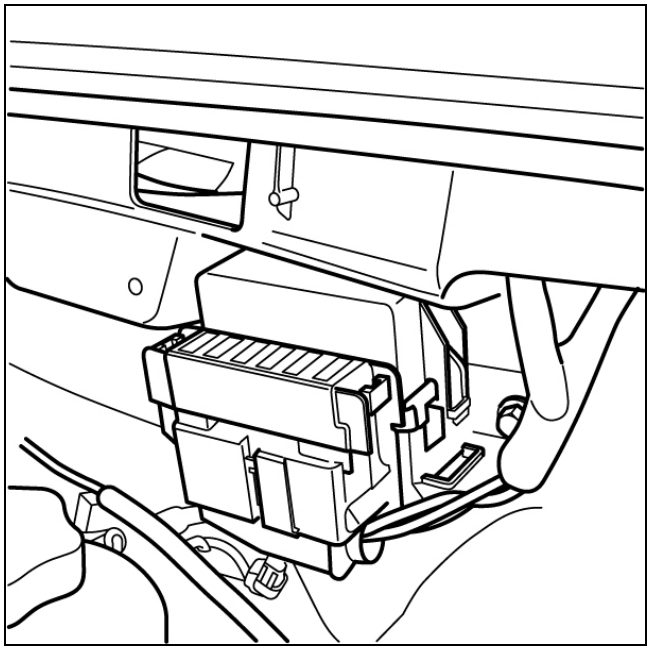


Figure 20 — Fuse Panel

The fuse panel is located on the bulkhead under the hood on the driver's side.

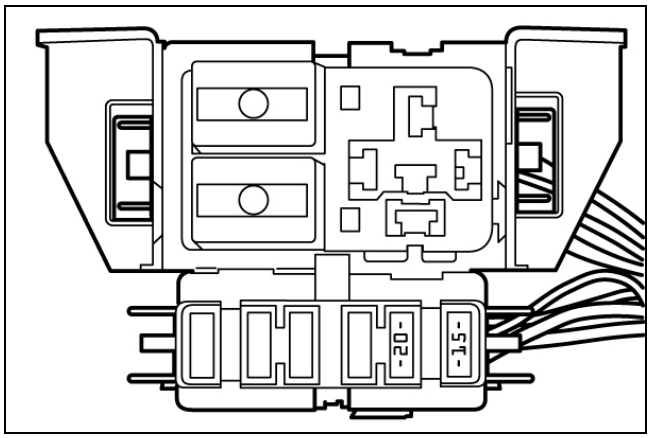


Figure 21 — 20 Amp and 15 Amp Fuses

Always use a fuse of the correct amperage when replacing fuses.

Current as of 02/11/2011

Pressure Relief

There are two means of relieving excess pressure in the tank; the pressure relief valve in the Multivalve and the bleeder valve in the tank wall (or remote bleeder valve on frame rail) that is separate from the Multivalve.

The pressure relief valve in the Multivalve vents excess pressure to the atmosphere through a hose that directs the release to a point at the bottom of a rear wheel opening. The pressure relief hose (if applicable) clamps to an elbow that attaches the cover to the Multivalve. The pressure relief hose, elbow and Multivalve cover are removable while the tank is in the vehicle.

The bleeder valve vents immediately to the atmosphere. This valve can be serviced using a standard box end wrench while the tank is in the vehicle. Later models are equipped with a remote bleeder valve and hose assembly mounted on the frame rail, which can be serviced independently.

Purging

Clearing the propane out of the fuel lines (purging) is required before attempting to remove any of the components. Following the suggested techniques for purging will discharge a minimum of the vapor harmlessly into the atmosphere and produce the least risk to life and property.

Make certain to observe the alert messages. They consist of reminders of **Dangers**, **Warnings** and **Cautions**. Other reminders may appear under the heading, **Notes**.

Several components attached to the Multivalve on the fuel tank cannot be removed from the Multivalve until after the fuel tank is removed from the vehicle. This includes the:

- fuel supply line
- fuel return line
- fuel fill line
- fuel pump control solenoid

The electrical harness attached to the tank is a permanent fixture and cannot be removed in the field.

Purging the Fuel Tank

A propane fuel tank must be empty of propane before it can be transported by a carrier. Due to the volume of fuel likely to be retained in the fuel tank, releasing the vapor to the atmosphere would be wasteful, unsafe and an extremely slow procedure without special equipment. It is suggested that a local, certified propane handling company be engaged to purge the fuel tank and recapture the fuel as the need requires.

Purging System Fuel Lines

1. Disconnect the 4-pin electrical connector at the frame rail on the driver's side near the fuel tank.

Note — This disconnects the power to the fuel pump.

2. Start the engine and let it run until it stalls.

Note — This purges the supply and return fuel lines of propane.

3. Turn off the ignition.

Current as of 02/11/2011

4. Disconnect the negative battery cable from the battery.

Manual Fuel Shutoff

Note — This procedure ensures that no propane leaves the fuel tank during service activity.

⚠ **Warning** — Care must be taken while working with liquid propane. All steps must be followed to prevent personal injury and component damage.

1. With the engine turned off, remove the negative battery cable from the battery.
2. If applicable, remove the spring clamp and pressure relief hose from the 90-degree elbow on the Multivalve cover.

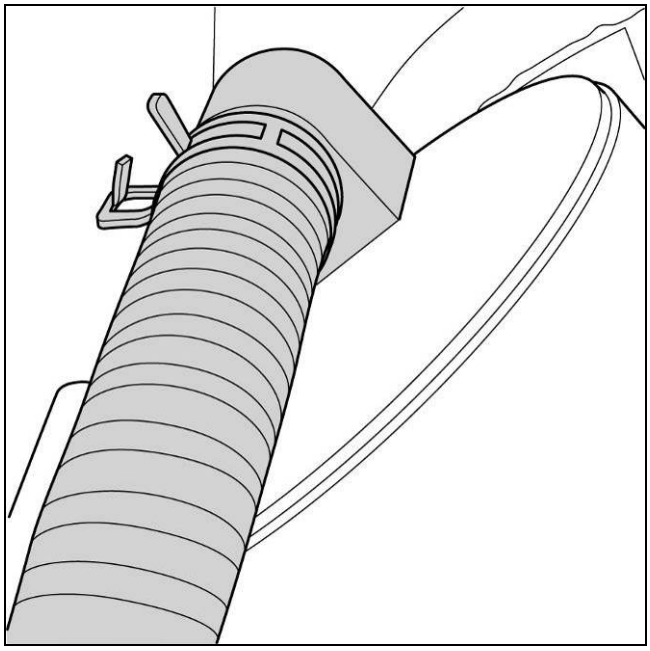


Figure 22 — Spring Clamp and Pressure Relief Hose

3. Remove the 90-degree elbow from the pressure relief valve on the Multivalve cover (turn counter-clockwise) and remove the cover.

Note — Some applications have a nut under the 90-degree elbow that must be removed prior to removing the cover.

⚠ **Caution** — If the 90-degree elbow or nut and tube assembly spins and cannot be removed, STOP and contact ROUSH CleanTech Customer Service at 1-800-597-6874.

4. With the cover removed, locate the manual shutoff valve. Turn the manual shutoff valve clockwise until it stops. The propane supply from the tank is now shut off.

Current as of 02/11/2011

Note — The manual shutoff valve can be hard to turn. From fully open to fully closed is approximately 2-1/2 turns.

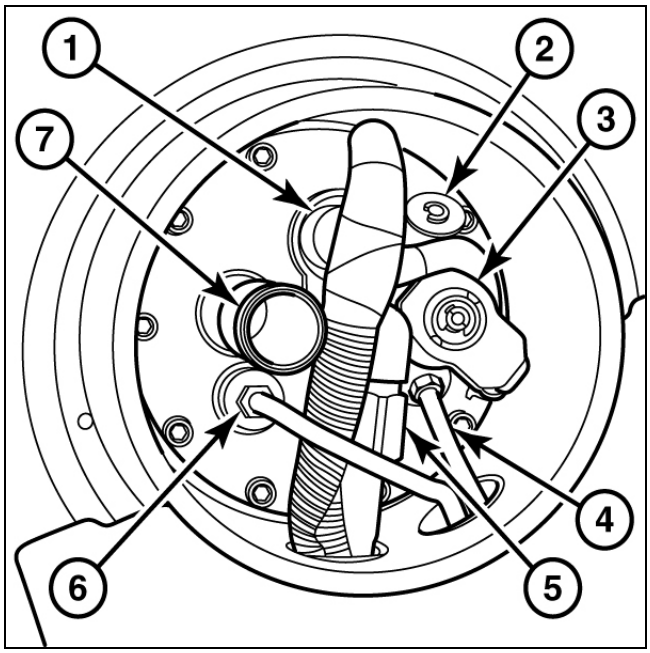


Figure 23 — Multivalve Assembly

1. Electrical Pass Through (not serviceable) 2. Manual Shutoff Valve 3. Fuel Supply Solenoid 4. Fuel Supply Line	5. Fuel Filler Inlet Elbow 6. Fuel Return Line 7. Pressure Relief Valve

Opening Manual Shutoff Valve

1. After fuel system service is completed, open the manual shutoff valve on the fuel tank, turning the valve counter-clockwise until it stops. Make sure to open the shutoff valve slowly. Releasing fuel quickly into an empty fuel line can set off a special check valve, which could restrict fuel flow.

Note — If difficulty occurs, close the manual shutoff valve completely and then open it again, slowly.

Note — The manual shutoff valve can be hard to turn. From fully open to fully closed is approximately 2-1/2 turns.

2. Install the Multivalve cover and attach the 90-degreee elbow to the pressure relief valve on the cover. Ensure that the elbow is tight and leads to the driver's side of the vehicle.

⚠ **Caution** — Hand tighten the 90-degree elbow to avoid cross threading. Failure to heed this caution can result in component damage.

Current as of 02/11/2011

Note — When installing the 90-degree elbow and brass tube to the Multivalve, use anti-seize on the threads prior to assembly.

3. Install the pressure relief hose (if applicable) to the 90-degreee elbow and attach the spring clamp.
4. Install the negative battery cable. Disable the ignition and crank the engine to purge the fuel lines. DO NOT START the engine.
5. With Snoop®, or similar product, leak check the injectors, fuel rails and lines. Repair as necessary.
6. Start and run the engine and check for diagnostic trouble codes. Repair as necessary. Any questions, please contact ROUSH CleanTech Customer Service at 1-800-597-6874.

Fuel System Component Removal Procedures

Removing Pressure Relief Hose

1. If applicable, disconnect the pressure relief hose from the outlet nozzle bracket at the inner rear fender support.

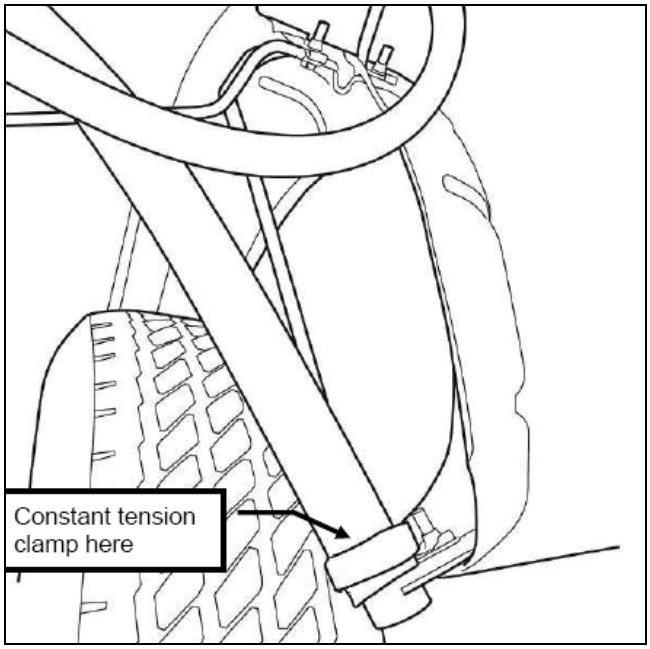


Figure 24 — Pressure Relief Hose Lower Connection

2. Disconnect the pressure relief hose from the 90-degree elbow in the Multivalve cover.

Current as of 02/11/2011

Removing Fuel Rail Pressure Control Module

1. Purge the propane from the fuel lines.

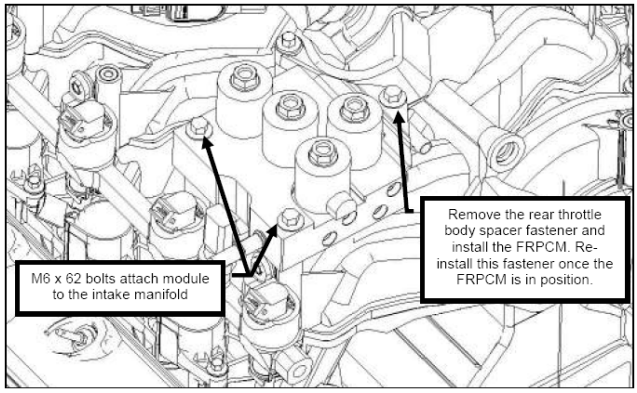

Remove the rear throttle body spacer fastener and install the FRPCM. Re-install this fastener once the FRPCM is in position.
M6 x 62 bolts attach module to the intake manifold

Figure 25 — Fuel Rail Pressure Control Module (FRPCM)

2. Close the manual shutoff valve on the tank.
3. Disconnect the FRPCM electrical connector.
4. Bend open the crimp tabs on the retention bracket.
5. Disconnect the forward fuel supply line from the upper right port of the FRPCM.
6. Disconnect the jumper fuel line from the RH fuel rail and from the lower right port of the FRPCM.
7. Disconnect the jumper fuel line from the LH fuel rail and from the upper left port of the FRPCM.
8. Disconnect the forward fuel return line from the lower left port of the FRPCM.
9. Disconnect the VMV 90-degree fitting from the FRPCM vacuum port.
10. Remove the bolts securing the FRPCM. Remove the FRPCM.

Removing Fuel Lines (Tank to Engine)

Note — The fuel supply and fuel return lines quick connected into the fuel tank (Multivalve) are serviceable only with the fuel tank removed.

1. Purge the propane from the fuel lines.
2. Close the manual shutoff valve on the tank.
3. Disconnect the tank fuel supply line from the forward (or intermediate) fuel supply line.

Current as of 02/11/2011

4. Disconnect the tank fuel return line from the forward (or intermediate) fuel return line.

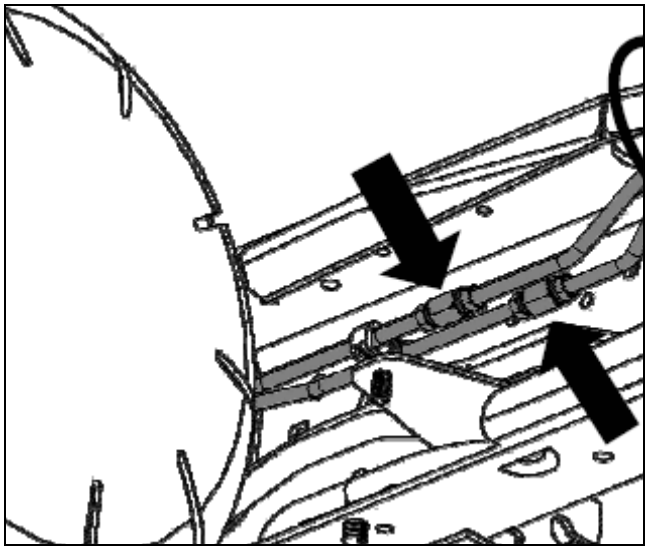


Figure 26 — Fuel Supply and Return Lines

5. Disengage the fuel lines from the retention clips on the frame rail, exhaust heat shield and bell housing fuel line retainer.
6. Disconnect the forward fuel supply line from the upper right port of the FRPCM.

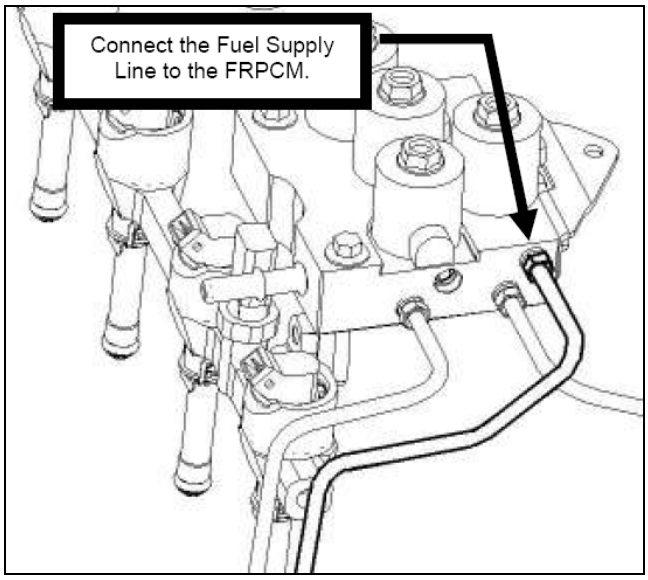


Figure 27 — Forward Fuel Supply Line at FRPCM

Current as of 02/11/2011

7. Disconnect the forward fuel return line from the lower left port of the FRPCM.

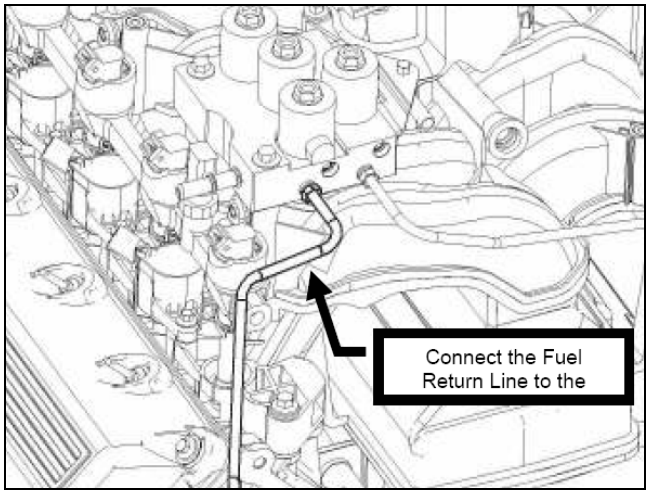


Figure 28 — Forward Fuel Return Line at FRPCM

8. Remove the forward fuel lines from the retention clips on the frame rail, heat shield and from the retention bracket on the bell housing.

Removing Fuel Fill Line (Filter to Tank)

Note — The fuel fill line cannot be disconnected from the Multivalve before the tank is removed from the vehicle.

⚠ **Danger** — A trace amount of propane fuel will be released when loosening the fittings. Propane settles to the lowest available surface before dissipating into the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

1. Close the manual shutoff valve on the tank.
2. Disconnect the fuel fill line at the fuel filter.

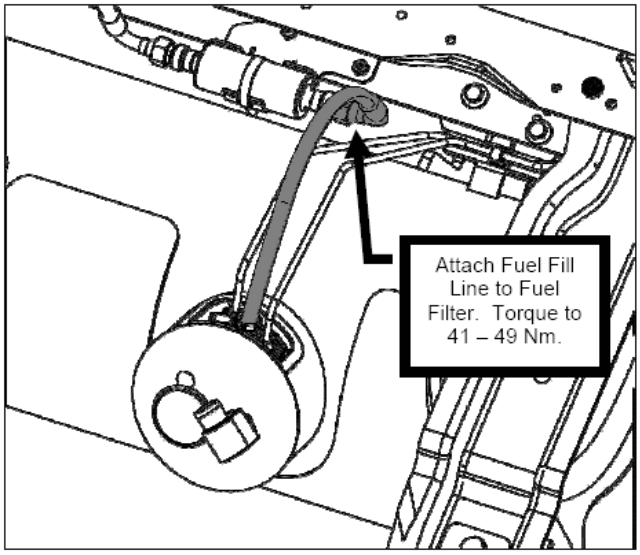


Figure 29 — Fuel Fill Line (Filter to Tank)

Current as of 02/11/2011

3. Remove the fuel tank to gain access to the fuel fill line on the tank.
4. Disconnect the fuel fill line.

Removing Fuel Filler Neck

⚠ **Danger** — A trace amount of propane fuel will be released when loosening the fittings. Propane settles to the lowest available surface before it dissipates into the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

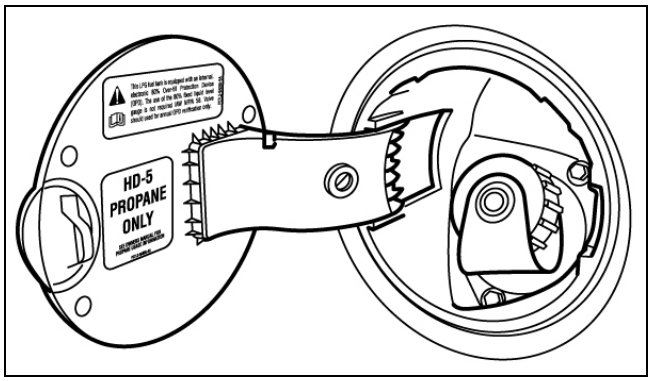


Figure 30 — Fuel Filler Door and Valve with Cap

1. Disconnect the fuel fill line at the fuel filler neck.
2. Remove the bolts holding the fill valve and the fuel filler neck to the vehicle side panel.
3. Remove the bolts attaching the fuel filler neck inside the fuel filler door.
4. Remove the fuel filler neck.

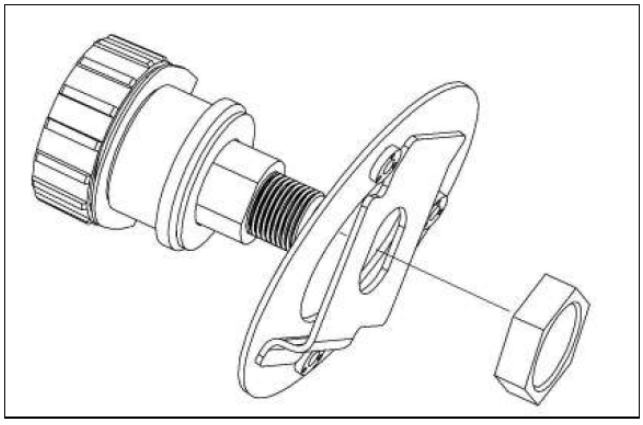


Figure 31 — Fill Valve and Fuel Filler Neck Mounting Bracket

5. Remove the fill valve-to-mounting bracket nut and separate the valve from the bracket.

Current as of 02/11/2011

Removing Fuel Filter Assembly

⚠ **Danger** — A trace amount of propane fuel will be released when loosening the fittings. Propane settles to the lowest available surface before it dissipates into the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

1. Disconnect the fuel fill line at the filter inlet.

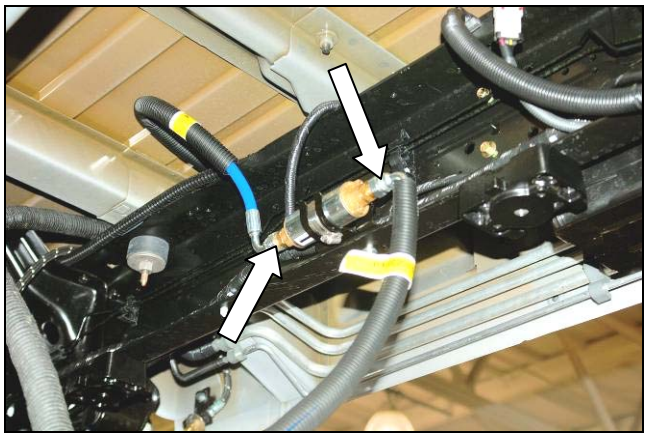


Figure 32 — Fuel Filter Assembly

2. Disconnect the fuel fill line at the filter outlet.
3. Loosen the fuel filter clamp.
4. Remove the fuel filter.

Removing Fuel Fill Line (Neck to Filter)

⚠ **Danger** — A trace amount of propane fuel will be released when loosening the fittings. Propane settles to the lowest available surface before it dissipates into the atmosphere. Keep heat, sparks, flames, static electricity or other sources of ignition out of the area when venting or purging the fuel lines or tank. Failure to heed this danger can result in severe personal injury or property damage.

1. Disconnect the fuel fill line from the inlet end of the fuel filter.

Current as of 02/11/2011

2. Disconnect the fuel fill line from the filler neck.

Figure 33 — Fuel Fill Line (Typical)

3. Remove the fuel fill line.

Removing Left (Driver's Side) Fuel Rail

1. Purge the propane from the fuel lines.
2. Disconnect the Mass Air Flow sensor electrical connector.
3. Remove the throttle body inlet hose.
4. Disconnect the heated PCV hose from the intake manifold.
5. Disconnect the Injection Pressure and Temperature Sensor (IPTS) electrical connector.

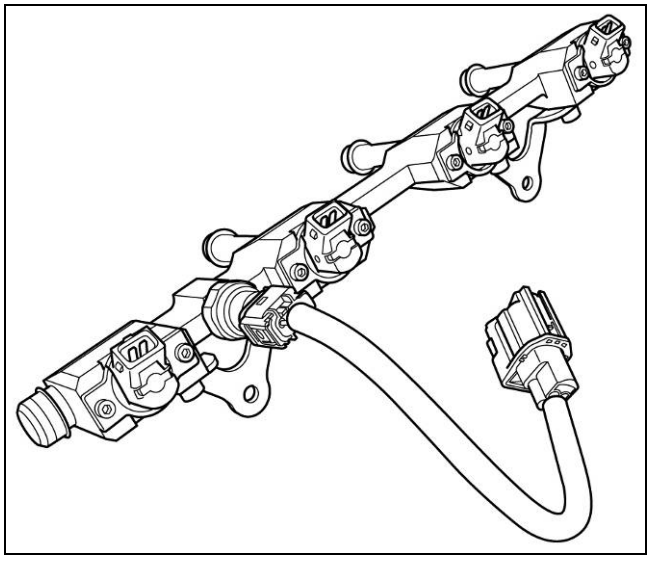


Figure 34 — Injection Pressure and Temperature Sensor and Fuel Rail

6. Disconnect the fuel injector electrical connectors.
7. Disconnect the fuel crossover fuel line.
8. Disconnect the fuel return line at the rear end of the fuel rail.

Current as of 02/11/2011

Note — In later applications the fuel supply and fuel return flow to the fuel rails is configured in parallel rather than in series. The Fuel Return Line and Tee Assembly connects the two fuel rails at the front with a tee connection to the FRPCM return fuel port. The Fuel Supply Line and Tee Assembly connects the two fuel rails at the rear with a tee connection to the FRPCM supply fuel port.

9. Remove the fuel rail with injectors.

Removing Right (Passenger's Side) Fuel Rail

1. Purge the propane from the fuel lines.

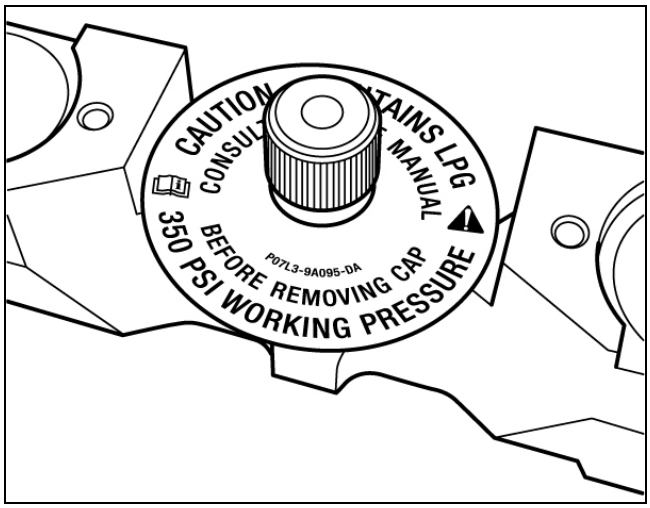


Figure 35 — Fuel Rail with Schrader Valve

2. Disconnect the PCV hose from the throttle body elbow.
3. Disconnect the fuel injector electrical connectors.
4. Disconnect the fuel supply line at the rear end of the right-side fuel rail.

Note — In later applications the fuel supply and fuel return flow to the fuel rails is configured in parallel rather than in series. The Fuel Return Line and Tee Assembly connects the two fuel rails at the front with a tee connection to the FRPCM return fuel port. The Fuel Supply Line and Tee Assembly connects the two fuel rails at the rear with a tee connection to the FRPCM supply fuel port.

Current as of 02/11/2011

5. Disconnect the crossover fuel line from the right-side fuel rail.

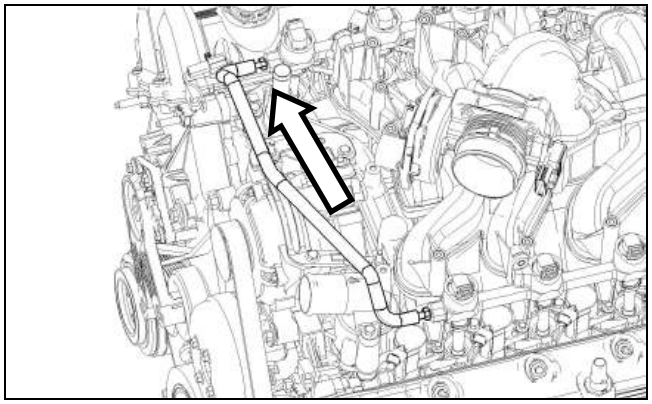


Figure 36 — Crossover Fuel Line (Early Applications)

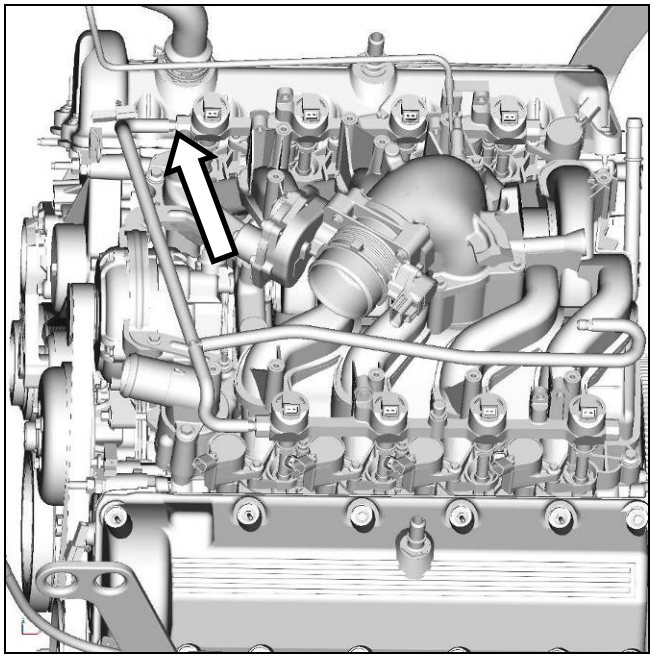


Figure 37 — Crossover Fuel Line (Later Applications)

6. Remove the fuel rail with injectors.

Current as of 02/11/2011

Removing Fuel Injector

1. Locate the fuel rail service port on the right-side fuel rail. Release the pressure in the fuel rail and lines.

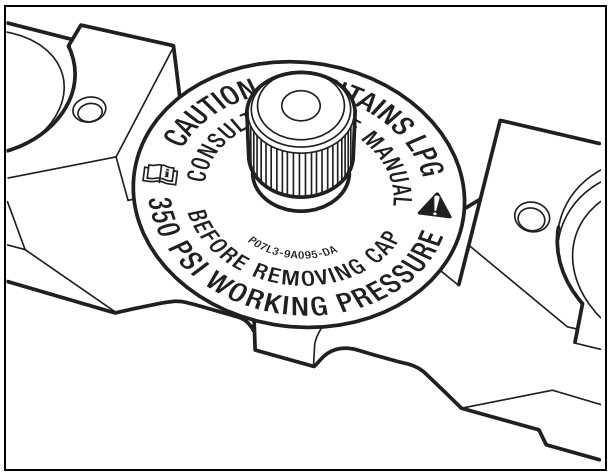


Figure 38 — Fuel Rail Service Port

⚠ **Caution** — The fuel rail is under high pressure. Care should be taken when releasing pressure to avoid personal injury.

2. Disconnect the fuel injector connector, remove the fuel injector hold down bracket bolts and remove the bracket.
3. Using a twisting motion, pull the fuel injector out of the fuel rail (a pair of pliers might be necessary to help remove the fuel injector). Use care to prevent damage to the fuel injector. As the fuel injector is being removed from the rail, make sure that the brass calibrator is still down inside the fuel rail and not on the fuel injector.

Note — The brass calibrator is assembled with the nozzle and screwed into the bottom of the fuel rail. Replacing the fuel injector does not require removal of the calibrator and nozzle, but in some instances the calibrator can come out of the fuel rail when the fuel injector is removed.

4. Repeat Steps 2–3 as needed for the remaining fuel injectors.

Current as of 02/11/2011

Removing Injection Pressure and Temperature Sensor

1. Purge the propane from the fuel lines.

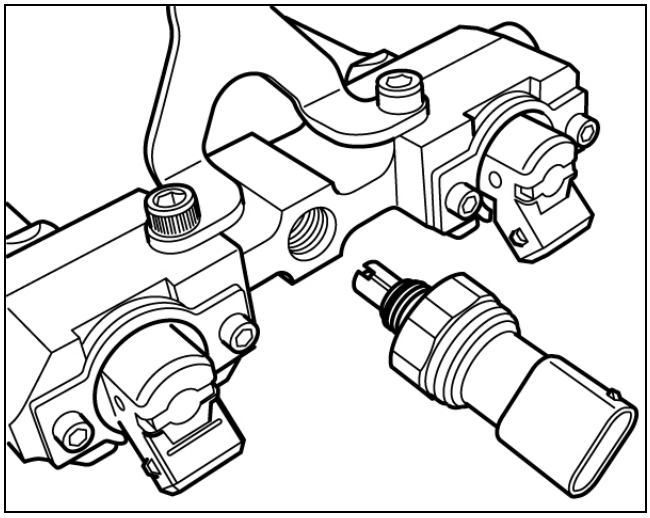


Figure 39 — Injection Pressure and Temperature Sensor

2. Disconnect the electrical connector from the Injection Pressure and Temperature Sensor (IPTS).
3. Remove the IPTS from the left-side fuel rail.

Fuel Tank Removal Procedures

Purging Fuel Tank

A propane fuel tank must be empty of propane before it can be transported by a carrier. Due to the volume of fuel likely to be retained in a tank, releasing the vapor to the atmosphere would be wasteful, unsafe and an extremely slow procedure without special handling equipment. It is suggested that a certified propane handling company be engaged to purge the fuel tank as needed.

Removing Under-Vehicle Tank

Note — Locate a suitable place to put the fuel tank so that it can be worked on after being removed from the vehicle. The tank might also require temporary storage in preparation for shipment.

Note — Close the manual shutoff valve to ensure that no propane leaves the fuel tank during service activity.

⚠ **Warning** — Care must be taken while working with liquid propane. All steps must be followed to prevent personal injury and component damage.

1. Purge the propane from the fuel lines.
2. With the engine turned off, remove the negative battery cable from the battery.

Current as of 02/11/2011

3. If applicable, remove the spring clamp and pressure relief hose from the 90-degree elbow on the Multivalve cover. Secure the pressure relief hose out of the way.

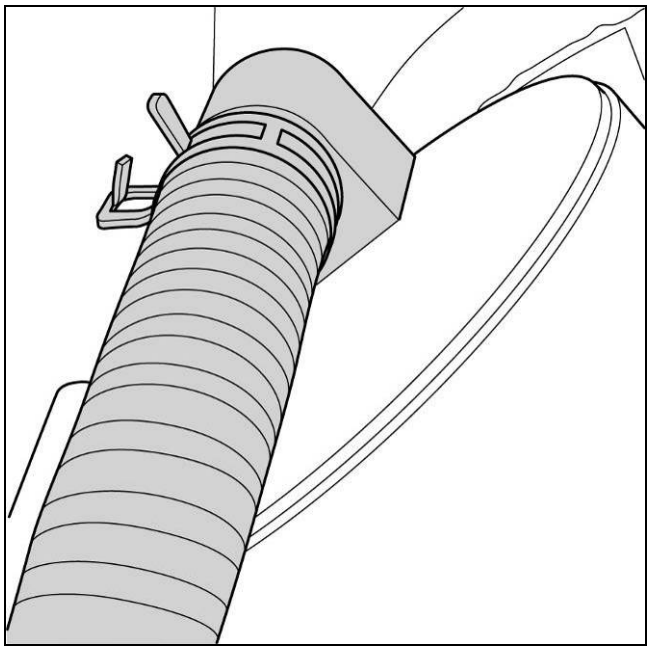


Figure 40 — Spring Clamp and Pressure Relief Hose

4. Remove the 90-degree elbow from the pressure relief valve on the Multivalve cover (turn counter-clockwise) and remove the cover.

Note — Some applications have a nut under the 90-degree elbow that must be removed prior to removing the cover.

⚠ **Caution** — If the 90-degree elbow or nut and tube assembly spins and cannot be removed, STOP and contact ROUSH CleanTech Customer Service at 1-800-597-6874.

5. With the cover removed, locate the manual shutoff valve. Turn the manual shutoff valve clockwise until it stops. The propane supply from the tank is now shut off.

Current as of 02/11/2011

Note — The manual shutoff valve can be hard to turn. From fully open to fully closed is approximately 2-1/2 turns.

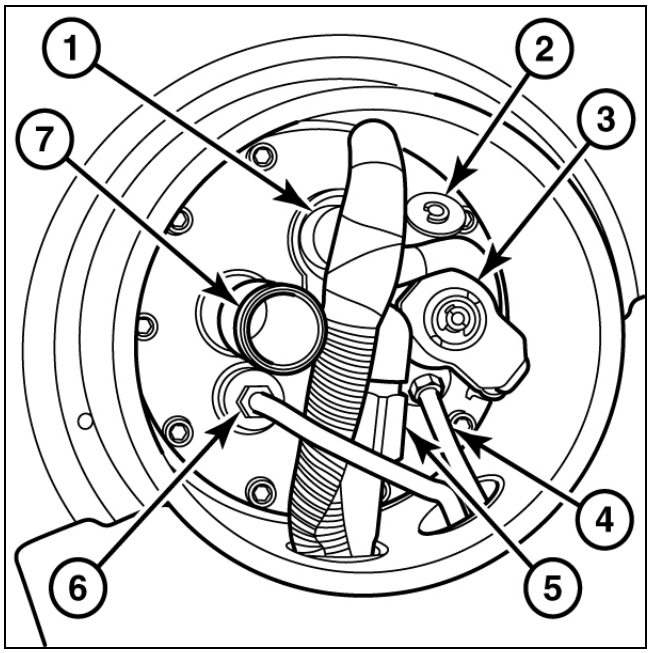


Figure 41 — Multivalve Assembly

1. Electrical Pass Through (not serviceable) 2. Manual Shutoff Valve 3. Fuel Supply Solenoid 4. Fuel Supply Line	5. Fuel Filler Inlet Elbow 6. Fuel Return Line 7. Pressure Relief Valve

Current as of 02/11/2011

6. Disconnect the fuel tank-to-filter fuel fill line at the outlet of the fuel filter.

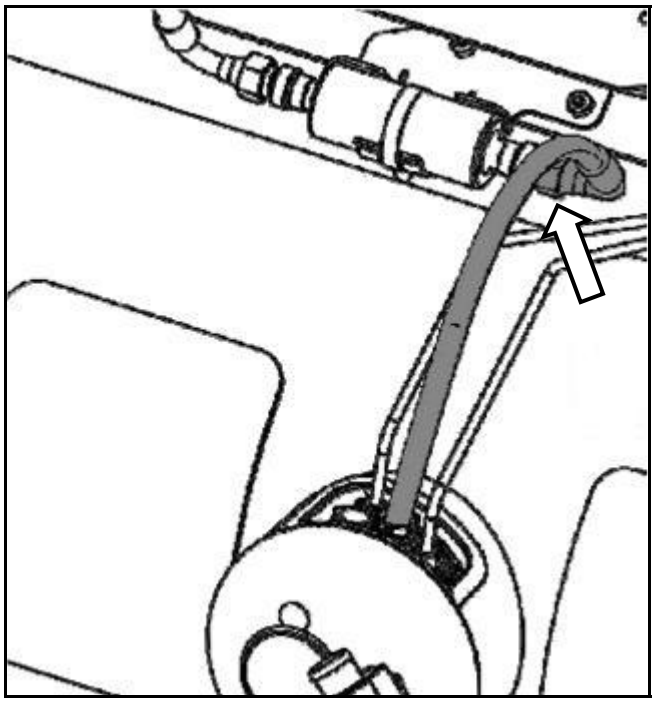


Figure 42 — Fuel Fill Line at Filter Outlet

7. Disconnect the fuel tank fuel supply line and fuel return line from the forward (or intermediate) fuel supply line and the forward (or intermediate) fuel return line.

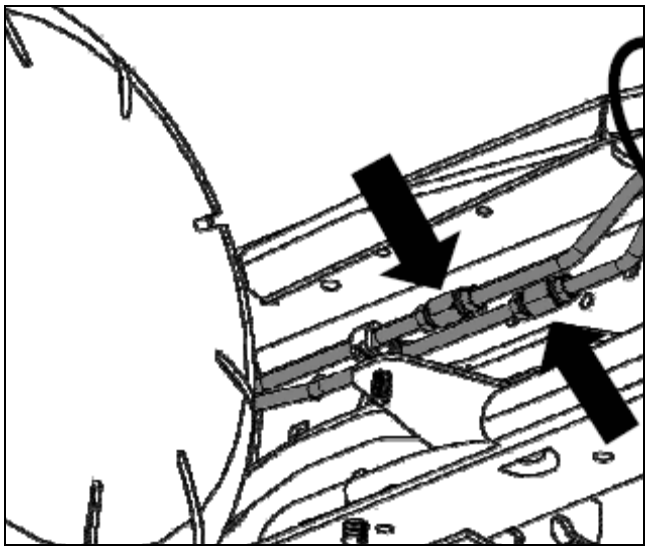


Figure 43 — Fuel Tank Fuel Supply and Fuel Return Line Connections

8. Detach the fuel lines from the double snail retaining clip (on fuel line support bracket, when applicable, just to the rear of the fuel line connections).
9. Obtain a hoist capable of safely lifting 1000 pounds. Attach the hoist to the fuel tank using lifting straps. Support the tank while removing the tank mounting fasteners.

Current as of 02/11/2011

10. Remove the nuts, bolts and steel washers attaching the tank to the left frame rail and to the front and rear crossmembers (later applications with dual tank use the right frame rail to secure the tank). Remove the mounting isolators and crush limiters as necessary.

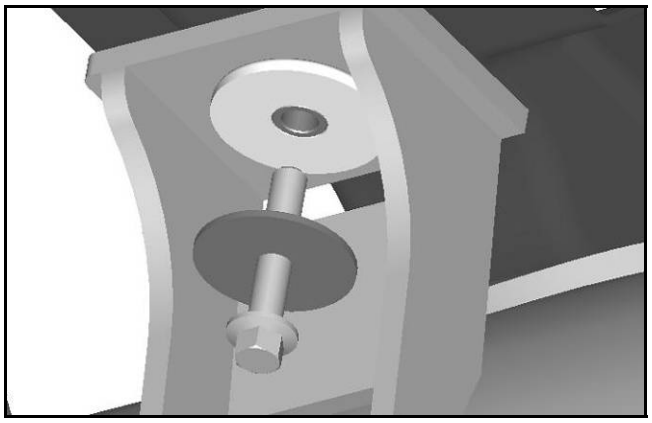


Figure 44 — Outboard Fuel Tank Mounting Bolt and Washer

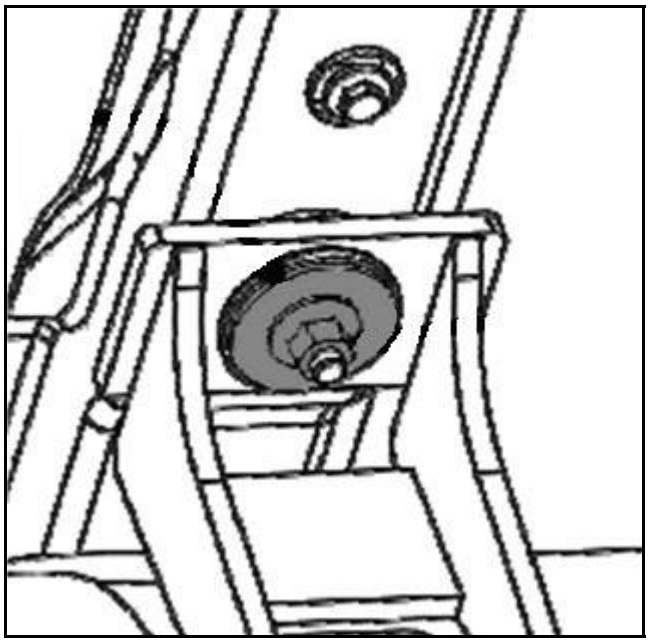


Figure 45 — Crossmember Fuel Tank Mounting Nut and Washer

11. With the help of an assistant, lower the tank approximately 12–18 inches to gain access to the fuel tank electrical connector.

Current as of 02/11/2011

12. Cut the tie straps and then disconnect the fuel tank 6-pin connector.

Figure 46 — Fuel Tank Electrical Connector (Typical)

13. Lower the tank from under the vehicle and place it on a suitable surface.

⚠ **Caution** — Fuel lines remain attached to the Multivalve and can extend below the tank support weldments. Ensure that clearance is provided when resting the tank on any surface. Failure to heed this caution can result in component damage.

14. Detach the hoist and remove the lifting straps.
15. Remove the convolute tubing from the fuel lines.
16. Remove the convolute tubing from the fuel fill line and the electrical cables.
17. Disconnect the fuel supply line and the fuel return line from the Multivalve quick-connect supply and return ports.

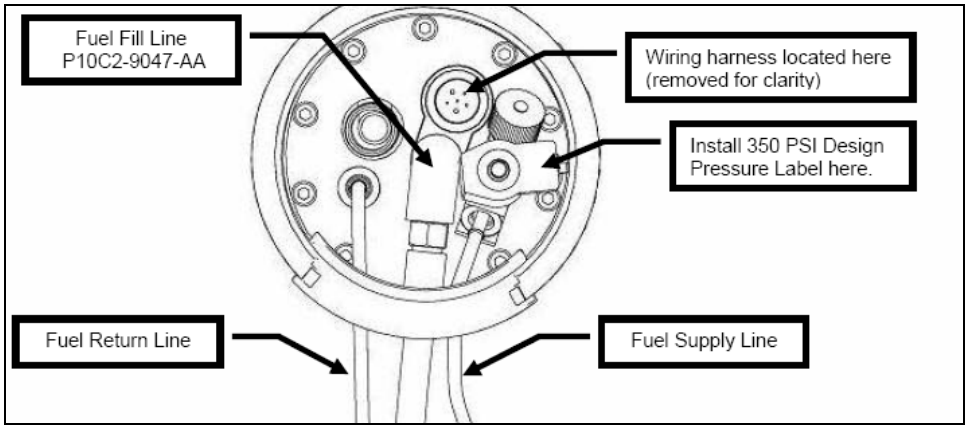


Figure 47 — Multivalve Connections

Current as of 02/11/2011

18. Disconnect the fuel supply and fuel return lines from the retention clip on the tank strap bracket.

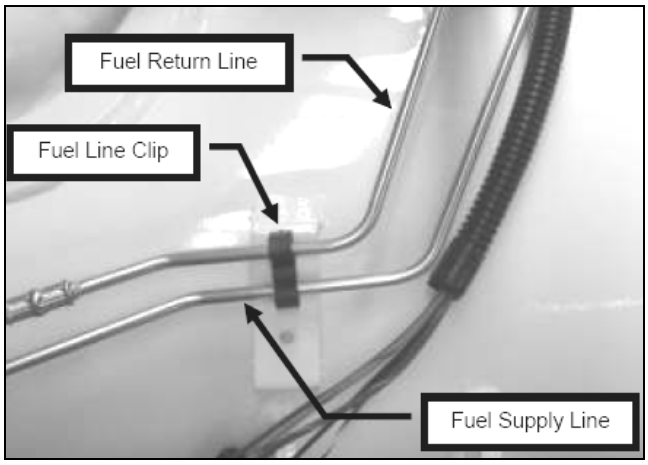


Figure 48 — Fuel Lines and Retention Clip (Typical)

19. Pull the fuel lines out of the tank collar grommet.
20. Remove the E-clip and pull off the fuel supply solenoid.
21. Remove the fuel fill line from the 90-degree fitting on the Multivalve.

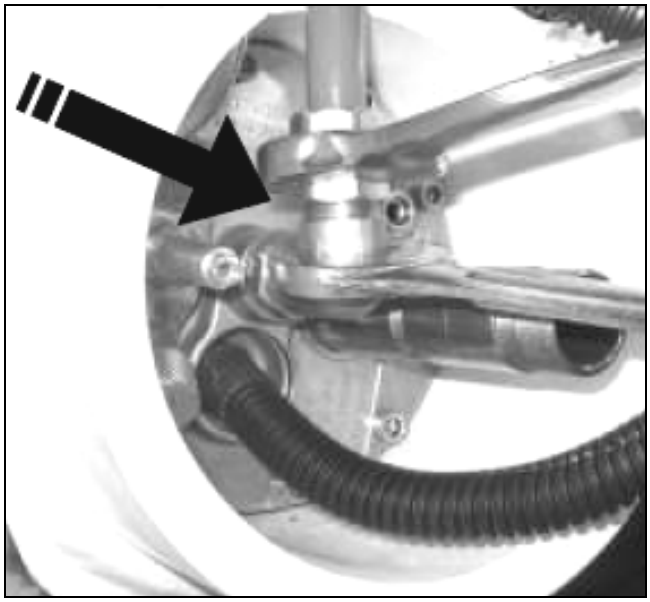


Figure 49 — Fuel Fill Line

22. Pull the fuel fill line through the tank collar grommet.
23. Remove the fuel tank collar grommet and carefully slide it off of the wiring harness.

Current as of 02/11/2011

Fuel Tank Installation Procedures

LPA System Bleed and Fill Procedure

The following procedure is required in order to ensure that the fuel system is leak-free and that any residual nitrogen is removed from the system. Failure to complete this process could result in leaks, excessive tank pressure and filling problems.

1. Bleed tank from the bleeder valve to ensure no air is present in the system. Close the bleeder valve.
2. Fill the tank with 0.1 (1/10) gallon of propane and cycle the ignition key to the crank position and then to the off position. **(Do not allow the vehicle to start during this step.)**
3. Inspect and monitor for any leaks.
4. Remove the bleeder valve cap and open the bleeder valve for 10 minutes or until propane stops bleeding, whichever comes first. Close the bleeder valve and install the bleeder valve cap.
5. Fill the tank with five gallons of propane.

Note — The next step confirms if any leaks are present in the fuel system.

6. Perform a final leak inspection at all fuel fill and fuel line connections to ensure no leaks are present using Snoop®, or a dish soap and water mixture.
7. Perform End Of Line (EOL) testing and road test.
8. Verify that there are no concerns and fill the vehicle and record the total amount of gallons to fill the vehicle.

Installing Under-Vehicle Tank

⚠ **Caution** — Hand tighten all fuel line connections and fasteners before using a wrench to avoid cross threading. Failure to heed this caution can result in component damage.

1. Insert the tank end of the fuel supply line (2) and the fuel return line (1) through the tank collar grommet (3).
2. Install the tank collar grommet onto the tank collar.

Current as of 02/11/2011

3. Carefully install the wiring harness through the upper right hole of the tank collar grommet.

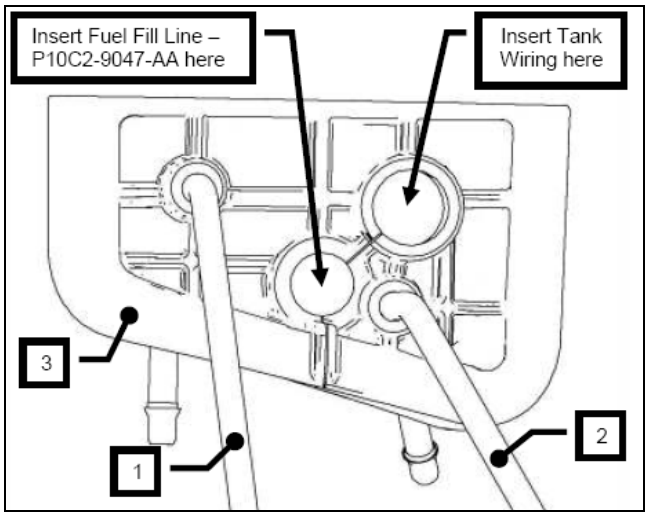


Figure 50 — Fuel Lines and Tank Collar Grommet

4. Install the fuel fill line through the lower center hole in the tank collar grommet.
5. Assemble the fuel fill line to the 90-degree fitting on the Multivalve. Support the fitting while tightening the fill line to the specified torque.

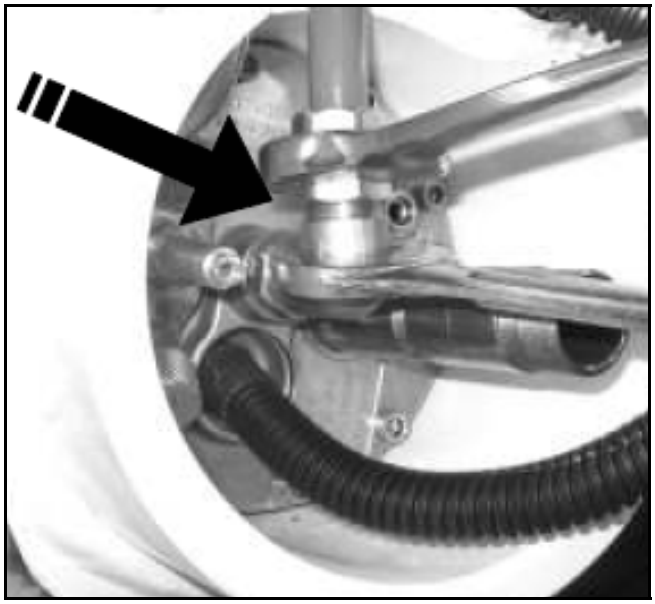


Figure 51 — Fuel Fill Line

6. Position the fuel supply solenoid and install the E-clip.

Current as of 02/11/2011

7. Connect the fuel supply line and the fuel return line to the Multivalve quick-connect supply and return ports. Give each line a firm pull to make sure that the quick connect fittings have locked into position.

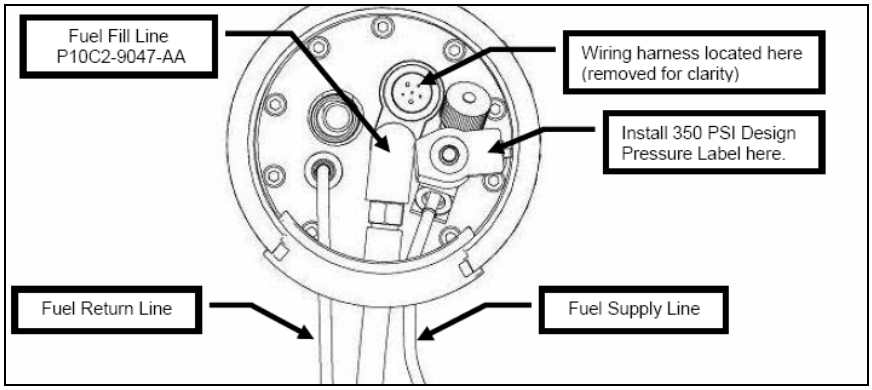


Figure 52 — Multivalve Connections

8. Connect the fuel supply and fuel return lines to the retention clip on the tank strap bracket.

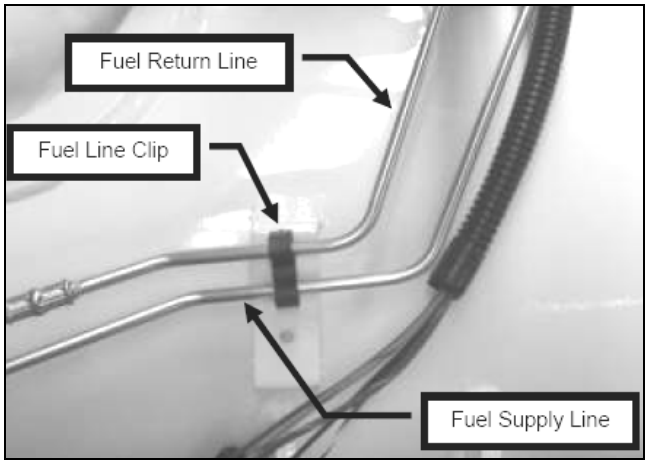


Figure 53 — Fuel Lines and Retention Clip (Typical)

9. Install the convolute tubing onto the fuel fill line and the electrical cables.

Current as of 02/11/2011

10. Install the convolute tubing over the fuel supply and return lines.

Figure 54 — Fuel Lines, Wiring and Convolute Tubing

11. Arrange the fuel lines and wiring harness as shown so that the Multivalve cover can be easily installed.

Note — There is a connector with two wires for engineering diagnostics at this time.

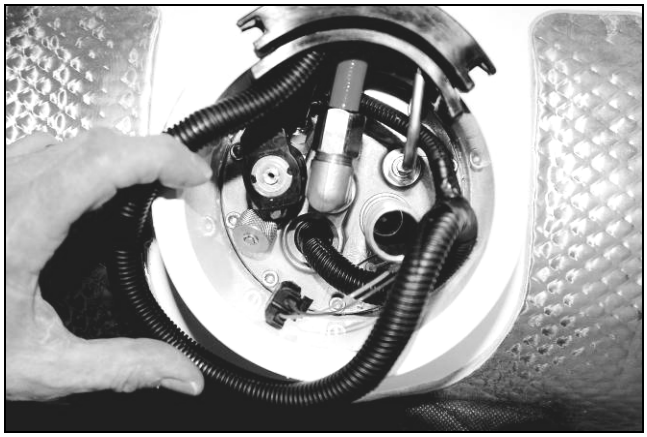


Figure 55 — Fuel Line and Wiring Arrangement

Current as of 02/11/2011

12. If removed, secure one rubber isolator to the top side of each of the tank mounting brackets. Use a high-strength fast-curing adhesive to keep the isolators in place.

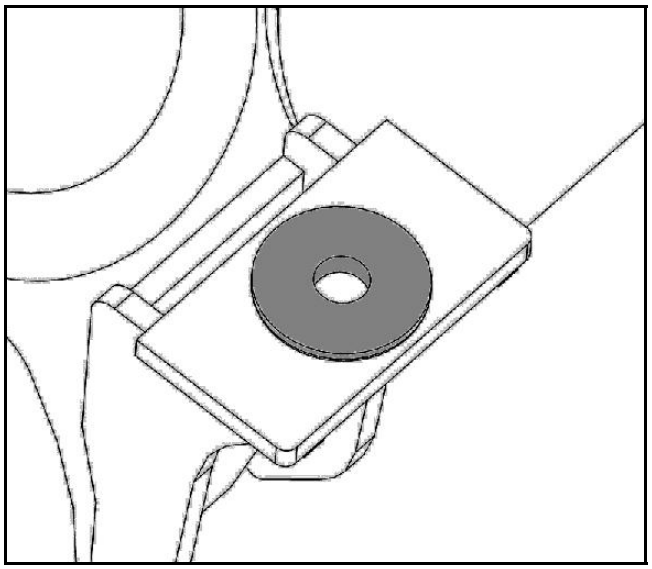


Figure 56 — Upper Isolator

13. Attach the hoist and the lifting straps to the fuel tank.
14. Position the fuel tank under the vehicle.
15. Tuck the fuel lines, fuel fill line and wiring harness up against the fuel tank. Slowly raise the tank to approximately 12–18 inches from its installed position.
16. Connect the fuel tank 6-pin connector to the main body harness connector. Install tie straps as necessary to secure the harness.

Figure 57 — Fuel Tank Electrical Connector (Typical)

Current as of 02/11/2011

17. Route the fuel fill line toward the outlet of the fuel filter. Connect the line to the filter after the fuel tank is fully installed.

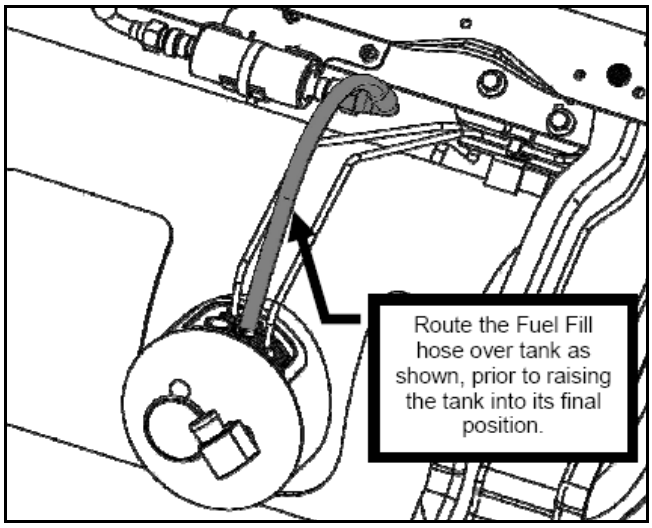


Figure 58 — Position Fuel Fill Line

18. Raise the fuel tank into position. Make sure to align the mounting holes of the tank with the four mounting bracket holes.
19. With the tank brackets aligned and fully seated on the frame and cross members, install the four crush limiters and tank mounting isolators.

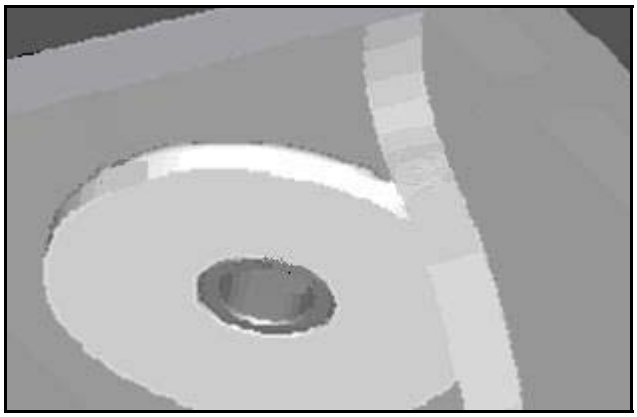


Figure 59 — Lower Isolator and Crush Limiter

Current as of 02/11/2011

20. Loosely install the steel washers and outboard tank mounting bolts into the frame mounts. Do not tighten until all tank mounting fasteners are aligned and installed.

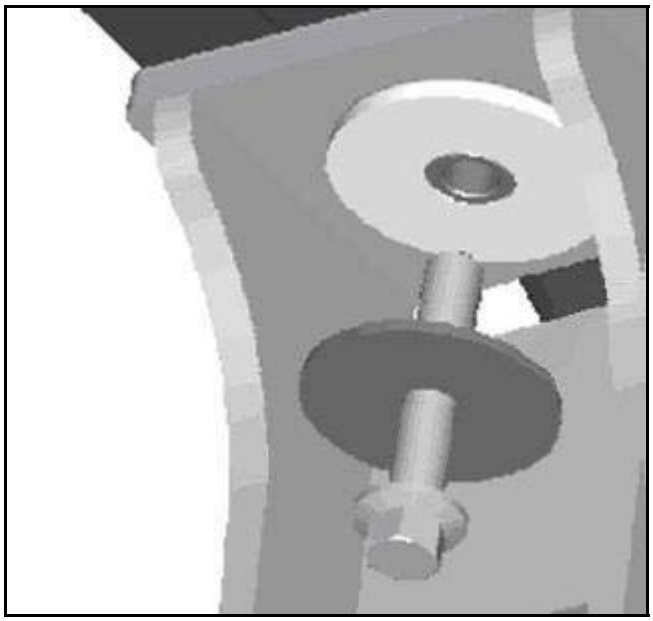


Figure 60 — Outboard Fuel Tank Mounting Bolt and Washer

21. Loosely install the two steel washers and nuts onto the front and rear crossmember bracket studs.

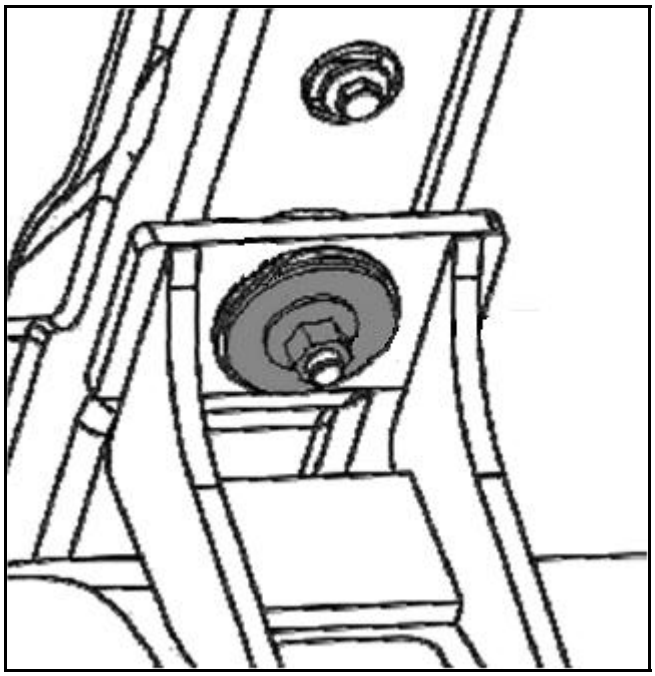


Figure 61 — Inboard Fuel Tank Mounting Nut and Washer at Crossmember

22. With all fuel tank mounting fasteners installed, tighten the two nuts and two bolts to the specified torque.

Current as of 02/11/2011

23. Connect the fuel supply line and fuel return line to the forward (or intermediate) fuel supply line and the forward (or intermediate) fuel return line. Tighten the fuel line fittings to the specified torque.

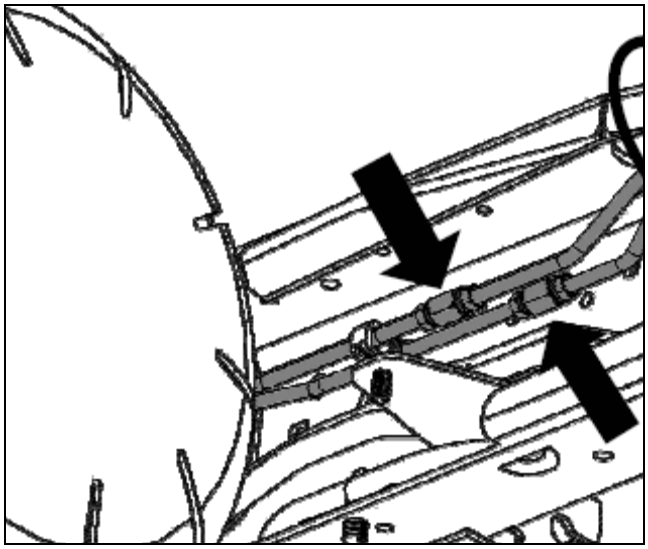


Figure 62 — Fuel Line Connections at Forward Fuel Lines

24. Attach the fuel lines to the double snail retaining clip (on fuel line support bracket just to the rear of the fuel line connections).
25. Connect the fuel tank-to-filter fuel fill line to the outlet of the fuel filter. Tighten the fitting to the specified torque.

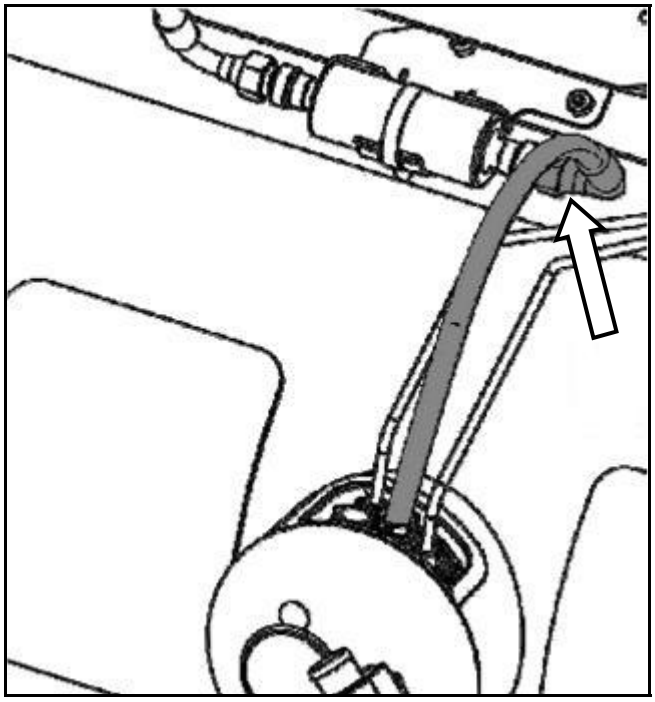


Figure 63 — Fuel Fill Line at Filter Outlet

Current as of 02/11/2011

26. Turn the manual shutoff valve counterclockwise until it stops. This opens the fuel supply to the system.

Note — The manual shutoff valve can be hard to turn. From fully open to fully closed is approximately 2-1/2 turns.

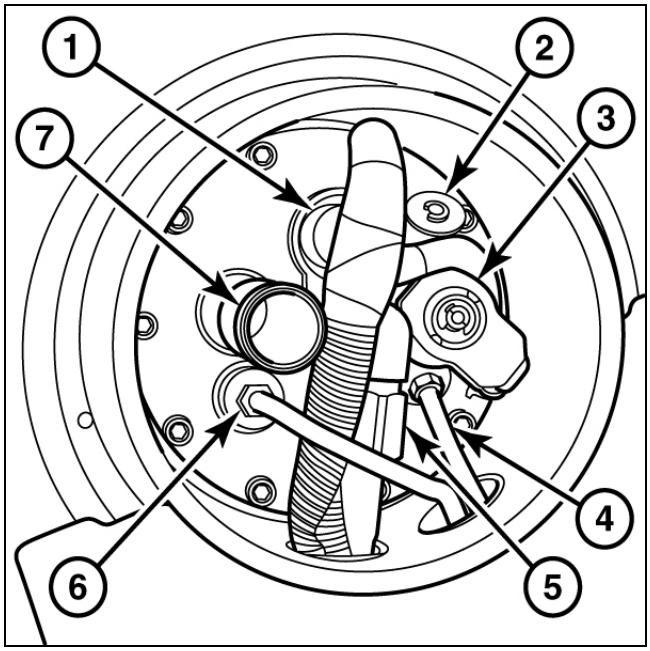


Figure 64 — Multivalve Assembly

1. Electrical Pass Through (not serviceable) 2. Manual Shutoff Valve 3. Fuel Supply Solenoid 4. Fuel Supply Line	5. Fuel Filler Inlet Elbow 6. Fuel Return Line 7. Pressure Relief Valve

27. Install the Multivalve cover and attach the 90-degree elbow to the pressure relief valve on the cover. Make sure the elbow is tight and leads to the driver's side of the vehicle, oriented toward the pressure relief hose.

⚠ **Caution** — Hand tighten the 90-degree elbow to avoid cross threading. Failure to heed this caution can result in component damage.

Note — When installing the 90-degree elbow and brass tube to the Multivalve, use anti-seize on the threads prior to assembly.

Current as of 02/11/2011

28. If applicable, install the pressure relief hose to the 90-degreee elbow and attach the spring clamp.

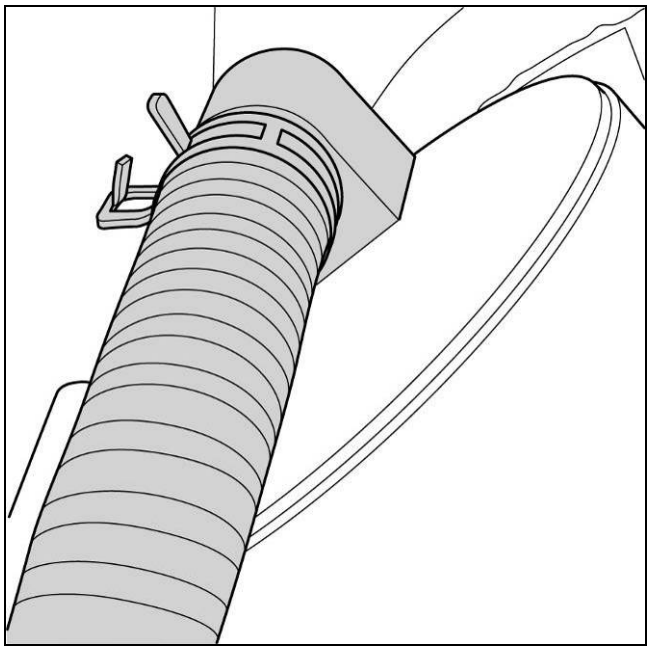


Figure 65 — Spring Clamp and Pressure Relief Hose

29. Install the negative battery cable.
30. Refer to the LPA System Bleed and Fill Procedure or follow the fuel tank documentation for the tank bleed and fill procedure. If there is no information provided with the tank, please contact ROUSH CleanTech Customer Service at 1-800-597-6874.
31. With Snoop®, or similar product, leak check the injectors, fuel rails and lines. Repair as necessary.
32. Start and run the engine and check for diagnostic trouble codes. Repair as necessary. Any questions, please contact ROUSH CleanTech Customer Service at 1-800-597-6874.

Current as of 02/11/2011

Fuel System Component Installation Procedures

Each of the following installation procedures is complete. If two or more procedures are required, they can be performed in any convenient order.

Before Installing Components

1. Ensure that the battery is disconnected.
2. Ensure that the ignition key is removed.
3. If the fuel tank is installed, ensure that the manual shutoff valve on the Multivalve is closed.

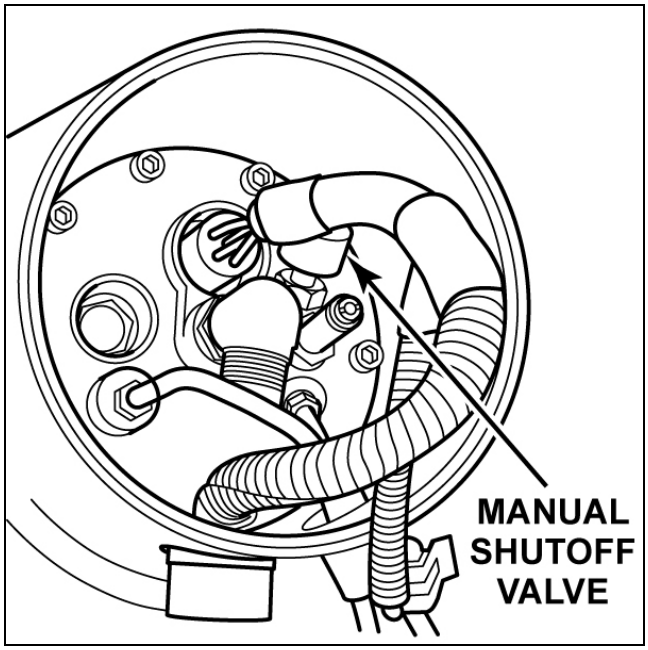


Figure 66 — Manual Shutoff Valve (Early Applications)

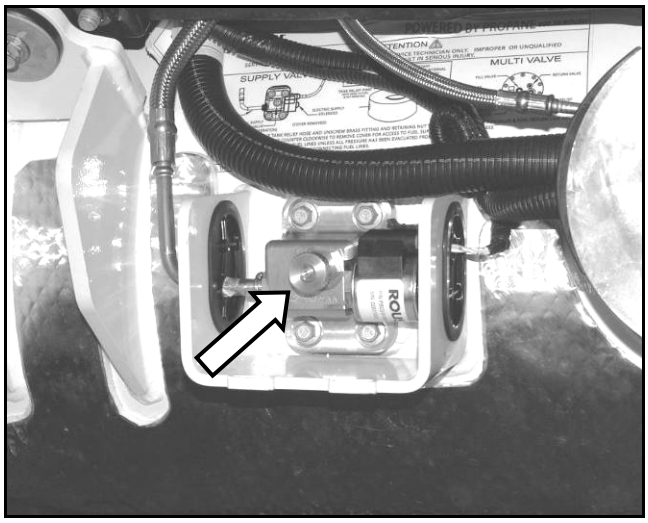


Figure 67 — Manual Shutoff Valve (Later Applications)

Current as of 02/11/2011

Installing Injection Pressure and Temperature Sensor

1. Install the Injection Pressure and Temperature Sensor (IPTS) into the left-side fuel rail.

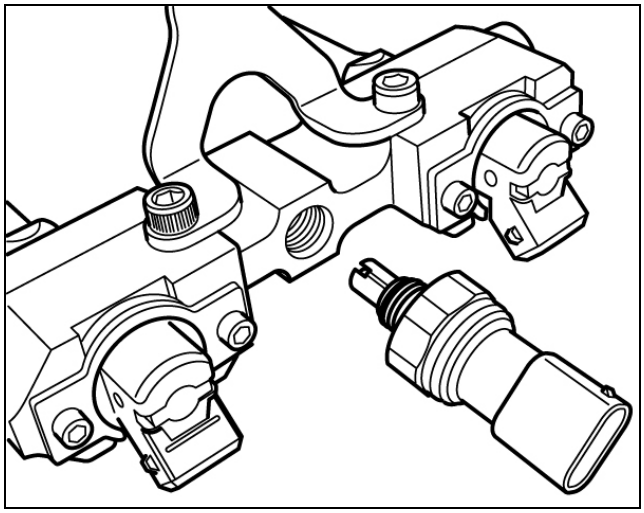


Figure 68 — Injection Pressure and Temperature Sensor

2. Connect the electrical connector to the IPTS.

Installing Fuel Injector

1. Lubricate the upper and lower fuel injector O-rings using SAE 5w20 motor oil or equivalent.
2. Install the fuel injector into the fuel rail with a twisting motion so that the electrical connection faces the fender of the vehicle (opposite the intake manifold) when the injector is fully seated.
3. Install the fuel injector hold down bracket and bolts. Tighten the fasteners to 3 N•m (27 lb-in). Install the fuel injector electrical connector.
4. Repeat the Removing Fuel Injector steps and Steps 1–3 of Installing Fuel Injector for the remaining fuel injectors as needed.

Installing Right (Passenger's Side) Fuel Rail

⚠ **Caution** — Hand tighten all fuel line connectors and fasteners before applying a wrench to avoid cross threading. Failure to heed this caution can result in component damage.

Assemble and lubricate new O-rings on the injector tips.
Position the right-side fuel rail assembly (with injectors) onto the passenger side of the intake manifold and fully seat the injector nozzles.

⚠ **Caution** — Make sure the fuel injectors are correctly aligned with the intake manifold before seating. Failure to heed this caution can result in component damage.

Current as of 02/11/2011

1. Install and tighten the right-side fuel rail bolts to the specified torque.

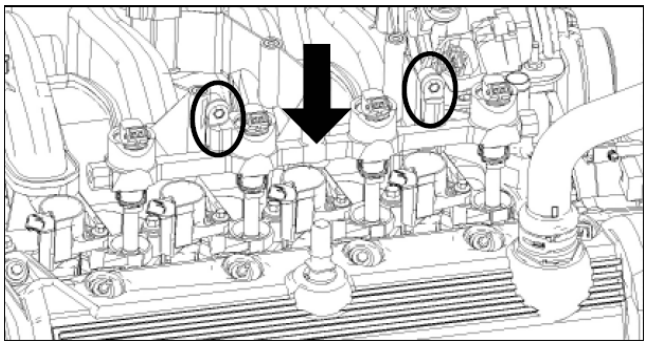


Figure 69 — Right-Side Fuel Rail

2. Connect the crossover fuel line to the right-side fuel rail and tighten to the specified torque.

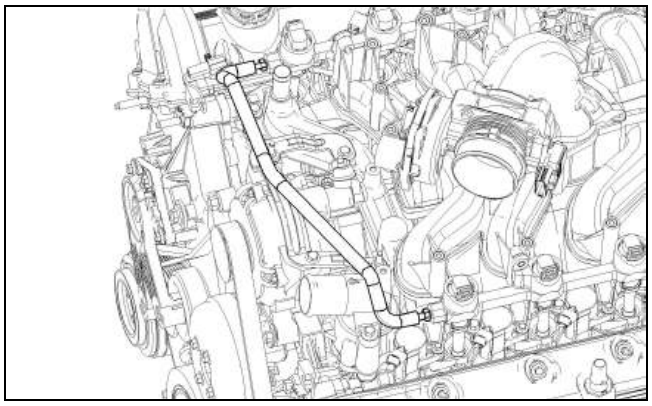


Figure 70 — Crossover Fuel Line

3. Connect the fuel supply line at the rear end of the right-side fuel rail.
4. Connect the fuel injector electrical connectors.
5. Connect the PCV hose to the throttle body elbow.
6. If no additional assembly is required, open the manual shutoff valve and install the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
7. Connect the battery.

Installing Left (Driver's Side) Fuel Rail

⚠ **Caution** — Hand tighten all fuel line connectors and fasteners before applying a wrench to avoid cross threading. Failure to heed this caution can result in component damage.

1. Assemble and lubricate new O-rings on the fuel injector tips.
2. Position the left-side fuel rail assembly (with injectors) onto the driver side of the intake manifold and fully seat the injector nozzles.

⚠ **Caution** — Make sure the fuel injectors are correctly aligned with the intake manifold before seating. Failure to heed this caution can result in component damage.

Current as of 02/11/2011

3. Install and tighten the fuel rail bolts to the specified torque.

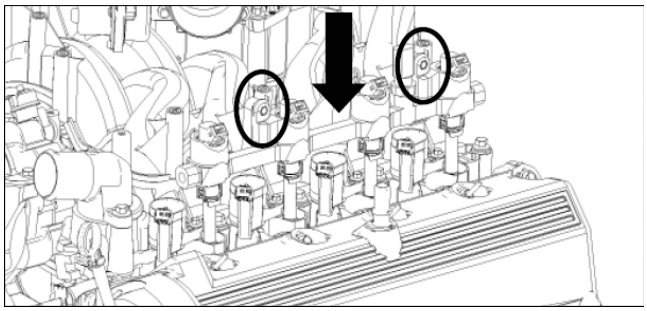


Figure 71 — Left-Side Fuel Rail

4. Connect the fuel return line at the rear end of the left-side fuel rail.
5. Connect the crossover fuel line to the left-side fuel rail and tighten to the specified torque.

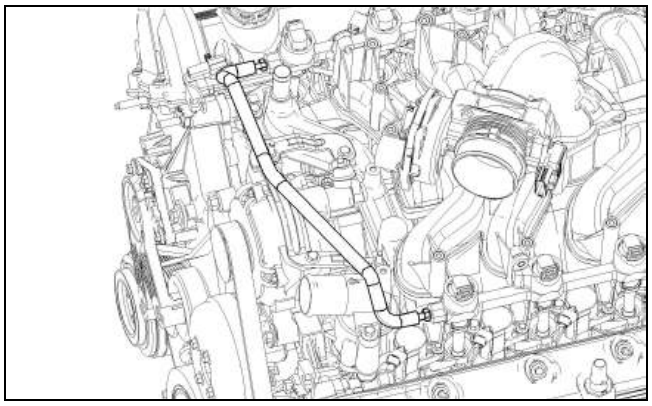


Figure 72 — Crossover Fuel Line

6. Connect the fuel injector electrical connectors.
7. Connect the Injection Pressure and Temperature Sensor (IPTS) electrical connector.

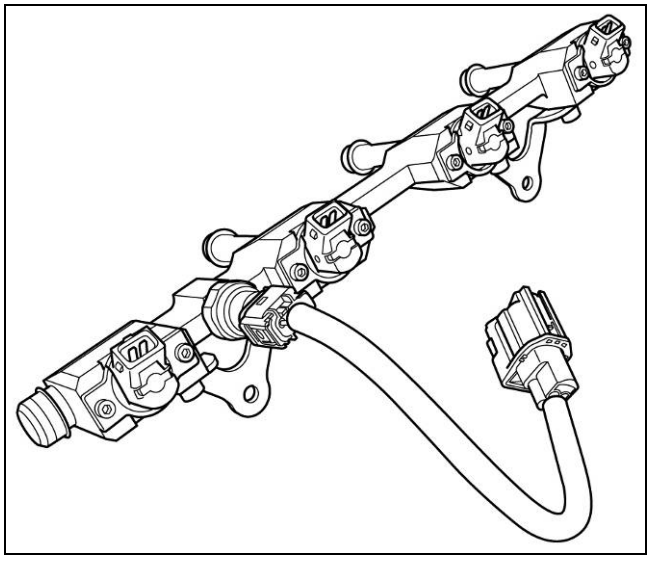


Figure 73 — Fuel Rail with Injection Pressure and Temperature Sensor

8. Connect the heated PCV hose to the intake manifold.

Current as of 02/11/2011

9. Attach the throttle body inlet hose.
10. Connect the Mass Air Flow sensor electrical connector.
11. If no additional assembly is required, open the manual shutoff valve and replace the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
12. Connect the battery.

Installing Fuel Filter Assembly

1. Assemble the filter assembly in the screw clamp.
2. Tighten the clamp screw to the specified torque.
3. Connect the line from the filler neck to the inlet end of the fuel filter and tighten to the specified torque.
4. Connect the line from the tank to the outlet end of the fuel filter and tighten to the specified torque.

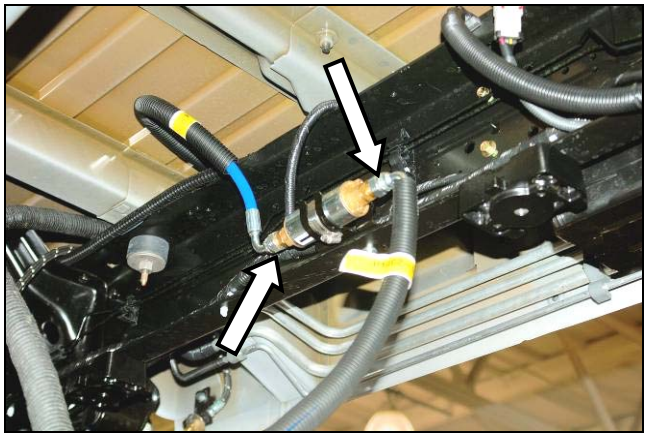


Figure 74 — Fuel Filter Assembly (Typical)

5. If no additional assembly is required, open the manual shutoff valve and replace the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
6. Connect the battery.

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Installing Fuel Filler Neck

⚠ **Caution** — Hand tighten all fuel line connectors and fasteners before applying a wrench to avoid cross threading. Failure to heed this caution can result in component damage.

1. Attach the fill valve to the fuel filler neck mounting bracket. Install the nut and tighten to the specified torque.

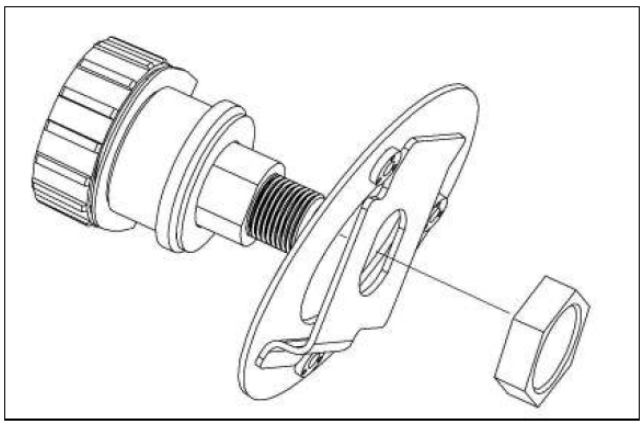

Figure 75 — Fill Valve and Fuel Filler Neck Mounting Bracket

2. Install the fill valve and fuel filler neck and mounting bracket to the vehicle side panel behind the vehicle fuel fill door. Install and tighten the bolts to the specified torque.

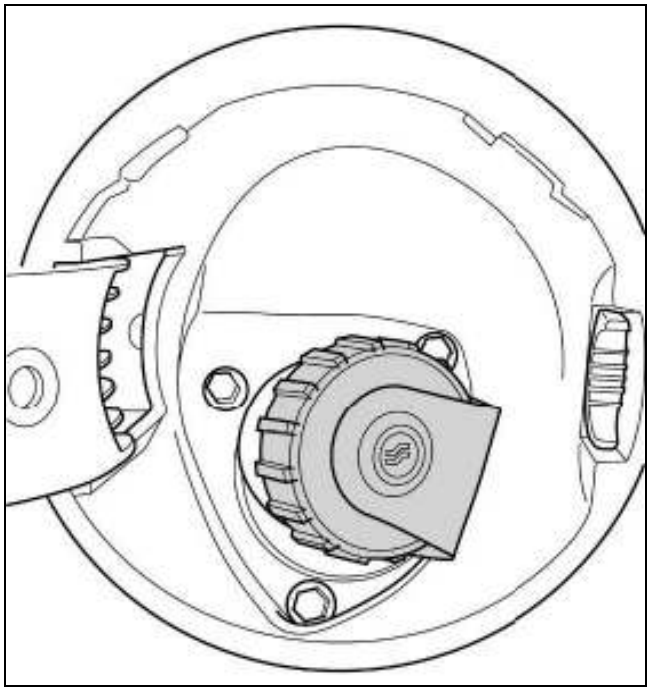

Figure 76 — Fuel Filler and Door

3. Install the fuel fill line to the fill valve and fuel filler neck.
4. If no additional assembly is required, open the manual shutoff valve and replace the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
5. Connect the battery.

Current as of 02/11/2011

Installing Fuel Fill Line (Filler Neck to Filter)

1. Connect the fuel fill line to the filler neck.

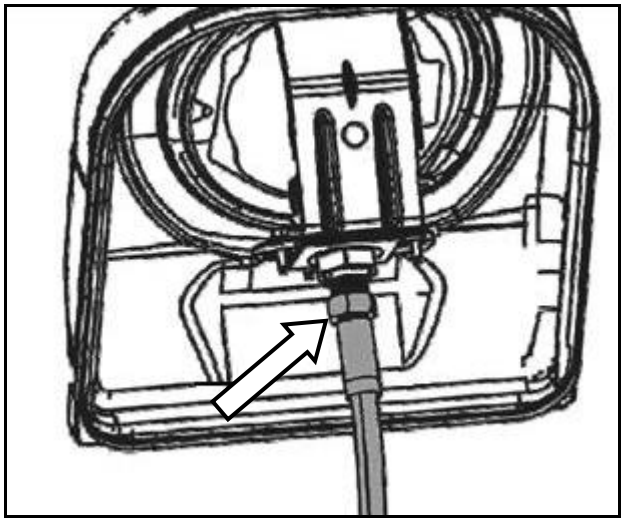

Figure 77 — Fuel Fill Line

2. Connect the fuel fill line to the inlet end of the fuel filter and tighten to the specified torque.
3. Install new cable ties as needed to secure the fuel fill line.
4. If no additional assembly is required, open the manual shutoff valve and replace the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
5. Connect the battery.

Installing Fuel Fill Line (Fuel Filter to Tank)

1. With fuel tank removed for access, thread the fuel fill line fitting to its port on the tank and tighten to the specified torque.
2. Install the fuel tank and position the fuel fill line for correct routing.

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3. Connect the fuel fill line securely to the outlet end of the fuel filter and tighten to the specified torque.

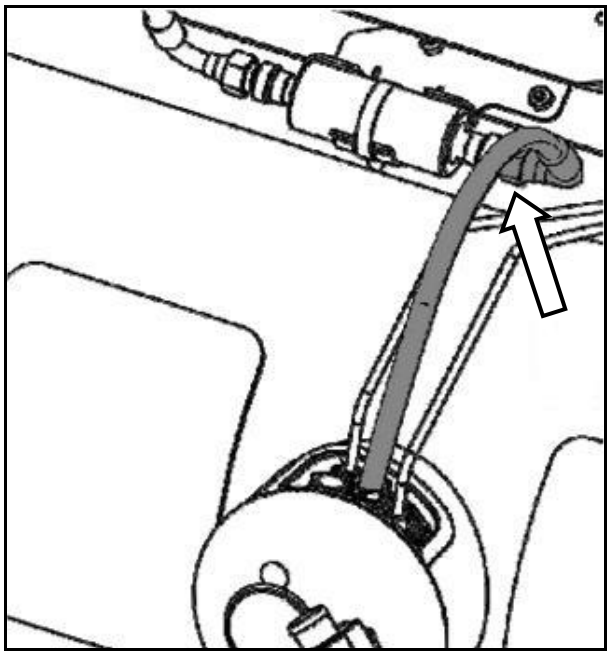

Figure 78 — Fuel Fill Line (Filter to Tank)

4. If no additional assembly is required, open the manual shutoff valve and replace the Multivalve cover, 90-degree elbow and pressure relief hose (if applicable).
5. Connect the battery.

Installing Fuel Lines (Tank to Engine)

Note — The fuel supply and fuel return lines quick connected into the fuel tank (Multivalve) are serviceable only with the fuel tank removed.

1. Route the forward fuel lines along the frame rail and into position for installation.
2. Connect the forward fuel return line to the lower left port of the FRPCM and tighten the fitting to the specified torque.

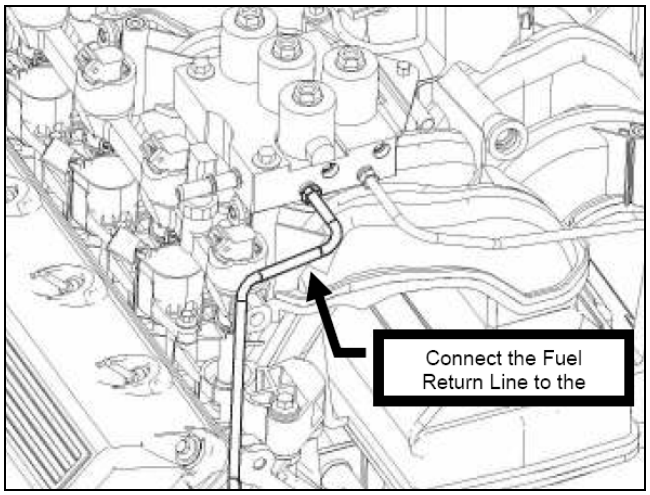

Figure 79 — Forward Fuel Return Line at FRPCM

Current as of 02/11/2011

3. Connect the forward fuel supply line to the upper right port of the FRPCM and tighten the fitting to the specified torque.

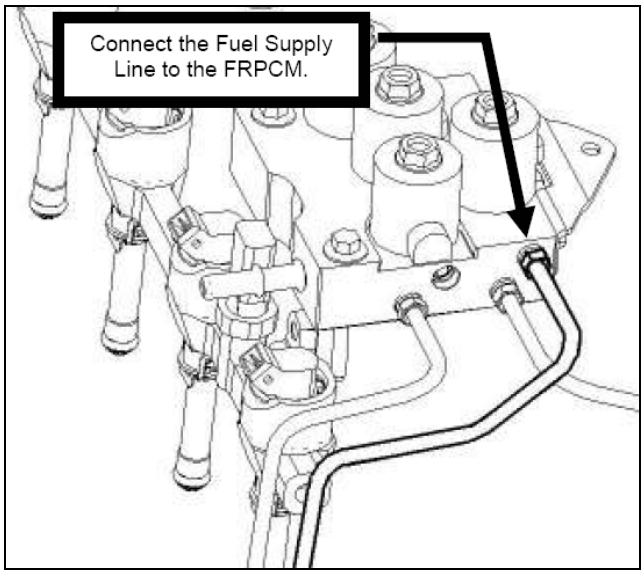

Figure 80 — Forward Fuel Supply Line at FRPCM

4. Attach the forward fuel lines to the retention clips on the frame rail, exhaust heat shield and to the retention bracket on the bell housing. Make sure all sleeves are positioned correctly between retention clips and bell housing bracket. Bend the crimp tabs to retain the fuel lines and VMV line.
5. Connect the tank fuel supply line to the forward (or intermediate) fuel supply line and tighten the fitting to the specified torque.
6. Connect the tank fuel return line to the forward (or intermediate) fuel return line and tighten the fitting to the specified torque.

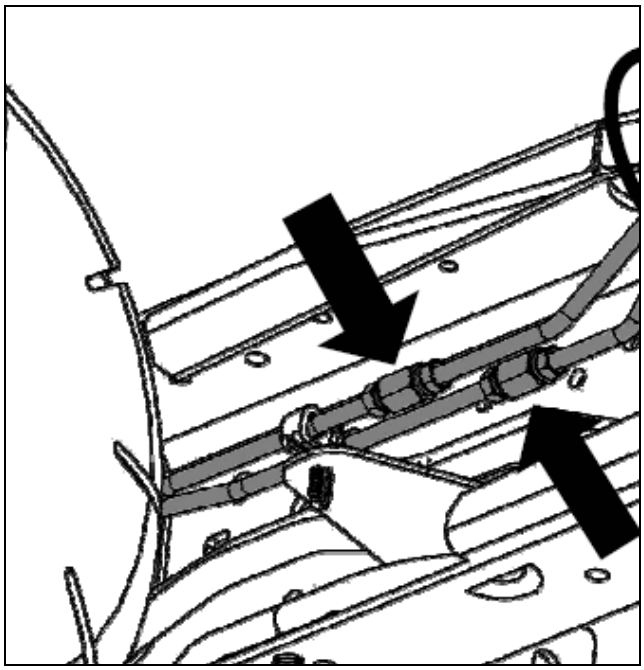

Figure 81 — Fuel Supply and Return Lines

Current as of 02/11/2011

7. Open the manual shutoff valve on the fuel tank.
8. Connect the battery.

Installing Fuel Rail Pressure Control Module

1. Position the FRPCM to the mounting location on the left rear of the intake manifold. Install the mounting bolts (one bolt through throttle body spacer) to secure the FRPCM and tighten to the specified torque.

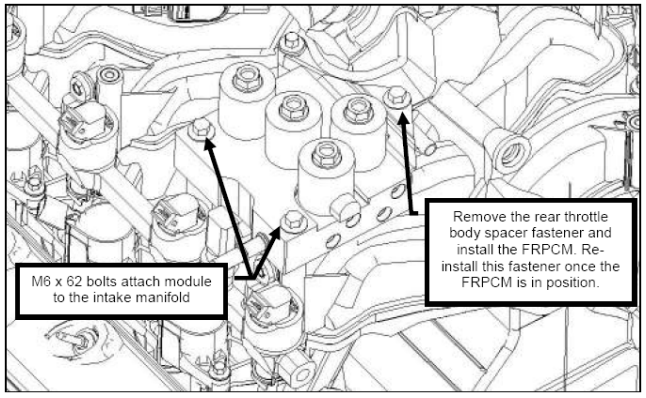
Remove the rear throttle body spacer fastener and install the FRPCM. Re-install this fastener once the FRPCM is in position.
M6 x 62 bolts attach module to the intake manifold

Figure 82 — Fuel Rail Pressure Control Module

2. Connect the jumper fuel line to the RH fuel rail and to the lower right port of the FRPCM.

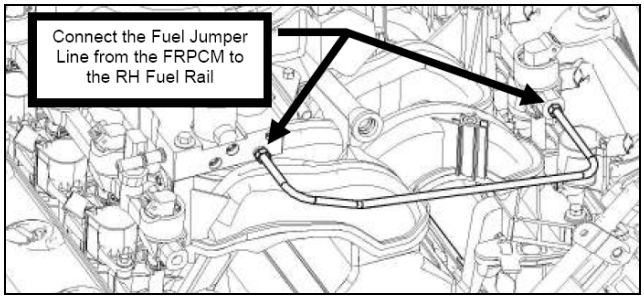

Figure 83 — Jumper Line to Fuel Rail

3. Connect the forward fuel return line to the lower left port of the FRPCM.

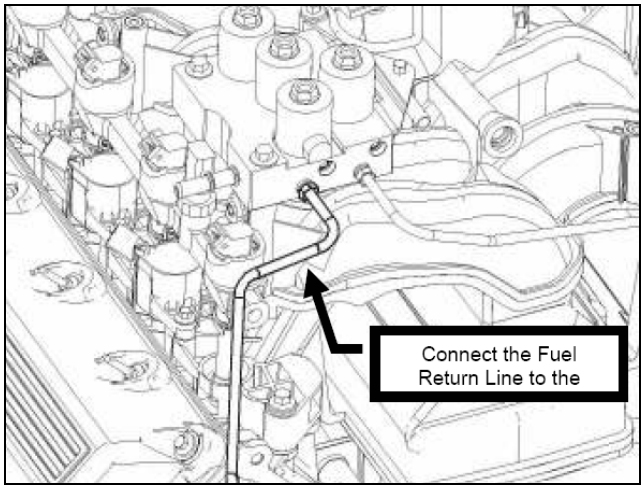

Figure 84 — Fuel Return Line to FRPCM

Current as of 02/11/2011

4. Connect the forward fuel supply line to the FRPCM.

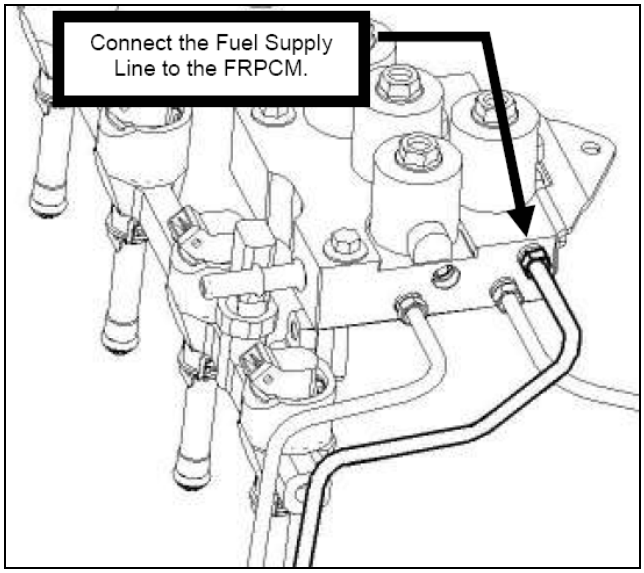

Figure 85 — Fuel Supply Line to FRPCM

5. Connect the jumper fuel line to the LH fuel rail and to the upper left port of the FRPCM.

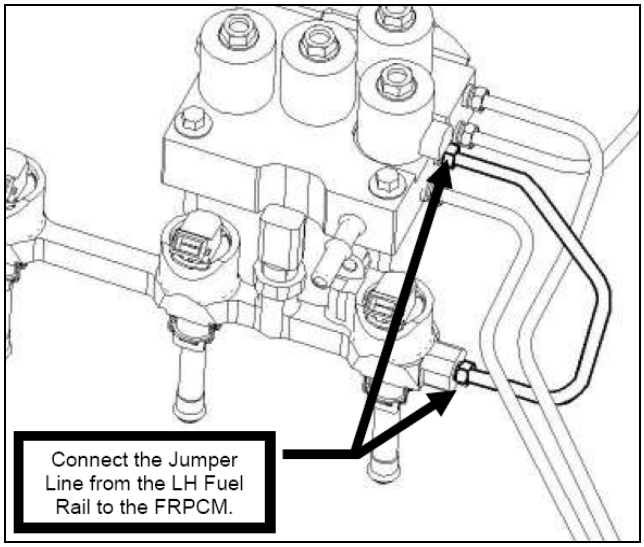

Figure 86 — Jumper Line to Fuel Rail

6. Tighten all fuel line connections to the specified torque.
7. Place the fuel lines in the retention bracket with sleeves and bend over the crimp tabs.
8. Connect the VMV 90-degree fitting to the FRPCM vacuum port.
9. Connect the FRPCM electrical connector.

Installing Pressure Relief Hose

1. Connect the pressure relief hose to the 90-degree elbow in the Multivalve cover. Retain with spring clamp.

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2. If applicable, connect the pressure relief hose to the outlet nozzle bracket at the inner rear fender support.

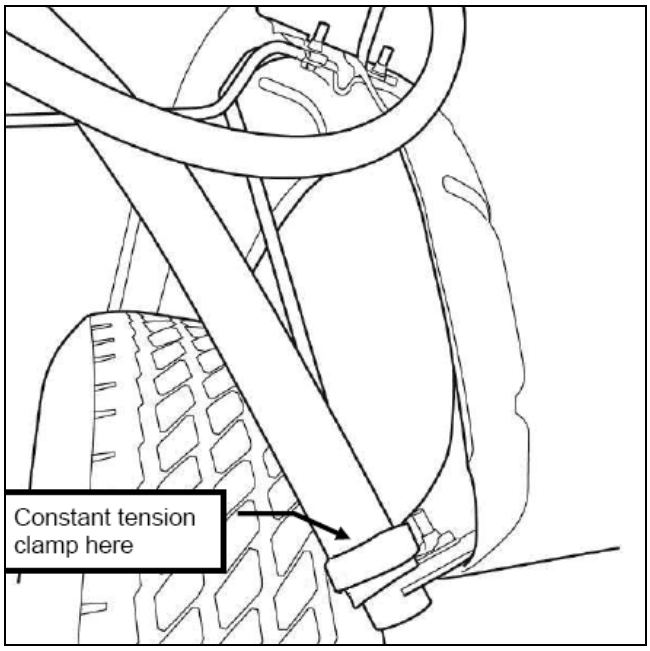


Figure 87 — Pressure Relief Hose Lower Connection

Current as of 02/11/2011

SPECIFICATIONS

Engine Specifications

ROUSH CleanTech Conversion Ford 5.4L LPI Engine

Bore and Stroke	90.2 mm x 105.7 mm
Compression Ratio	9.0:1
Displacement	5.4 Liters
Engine Architecture	V8 SOHC
Fuel System	Port Fuel Injection / Liquid Propane Injection
Peak Power Rating	255 HP
Peak Torque Rating	350 lb-ft
Transmission	4-Speed Automatic with Overdrive
Valve Operation	Variable Cam Timing
Valve Count	2 per cylinder
Valve Sizes	31.6 mm / 27.65 mm (Need Valve Sizes)
Equipment	
Air Conditioning	Standard
Heavy Duty Payload Package	Optional
Tires and Wheels	Variable with option package
Trailer Tow Package	Required

Chassis Specifications

		Regular/Extended
Model	**Cab/Body Type**	**Wheelbase**
E-150	Van, Cargo/Wagon	138”
E-250	Van, Cargo/Wagon	138”
E-350	Van, Cargo/Wagon	138”

Note — Vehicle dimensions are as quoted in the Ford Owner’s Guide except that options are available only as shown in the following table.

Current as of 02/11/2011

Fastener Torque Values

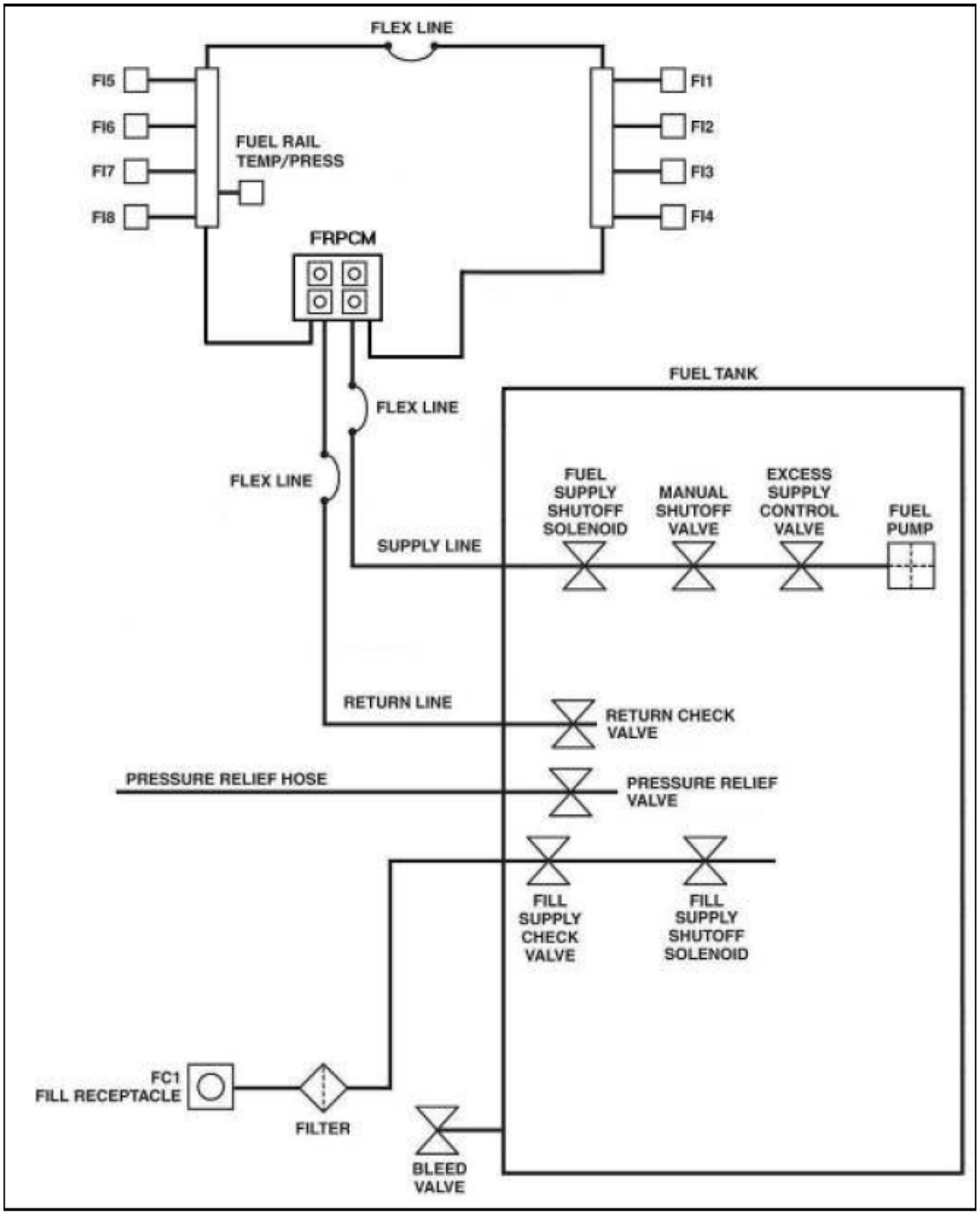
Fasteners, Fittings and Connections			
Part Description, Name	**N•m**	**Lb-Ft**	**Lb-In**
FRPCM-to-Bracket M6 Bolt	8-12	6-9	
FRPCM-to-Intake Manifold M6 Bolt	8-12	6-9	
Fuel Crossover Line Fitting	18-22	13-16	
Fuel Fill Hose Fittings (at Fill Valve and Fuel Filter)	41-49	30-36	
Fuel Fill Line Fittings (at Fuel Tank and Fuel Filter)	41-49	30-36	
Fuel Filter and Bracket Assembly M6 Bolt	20-30	15-22	
Fuel Filter-to-Bracket Clamp	4-5		35-44
Fuel Rail Crossover Fuel Line Fitting	18-22	13-16	
Fuel Line Support Bracket-to-Frame M8 Nut	20-30	15-22	
Fuel Rail Mounting M6 Bolt	8-12	6-9	
Fuel Supply and Return Line Fittings	18-22	13-16	
Fuel Lines at FRPCM	18-22	13-16	
Fuel Tank Crossmember Mounting Bracket (Front/Rear) M8 Bolt	20-30	15-22	
Fuel Tank Crossmember Mounting Bracket (Front/Rear) M12 Nut	80-90	59-66	
Fuel Tank M12 Mounting Bolt at Frame Rail Bracket (Front/Rear)	80-90	59-66	
Fuel Tank Mounting Bracket at Frame Rail M10 Bolt (Front/Rear)	40-55	30-41	
Fuse Box-to-Bracket Screw	Snug Tight		
IPTS Interface Module Screw	Snug Tight		
Multivalve Cover M24 Nut	Snug Tight		
Multivalve-to-Tank M6 Screw	5.5		49
Fill Valve and Bracket Assembly M5 Bolt	5-7		44-62
Fill Valve-to-Bracket Nut	Snug Tight		
Pressure Relief Outlet Nozzle Bracket	20-30	15-22	
Transmission Dipstick Bracket M6 Bolt	8-12	6-9	

Current as of 02/11/2011

SCHEMATICS

Fuel System Flow Diagrams

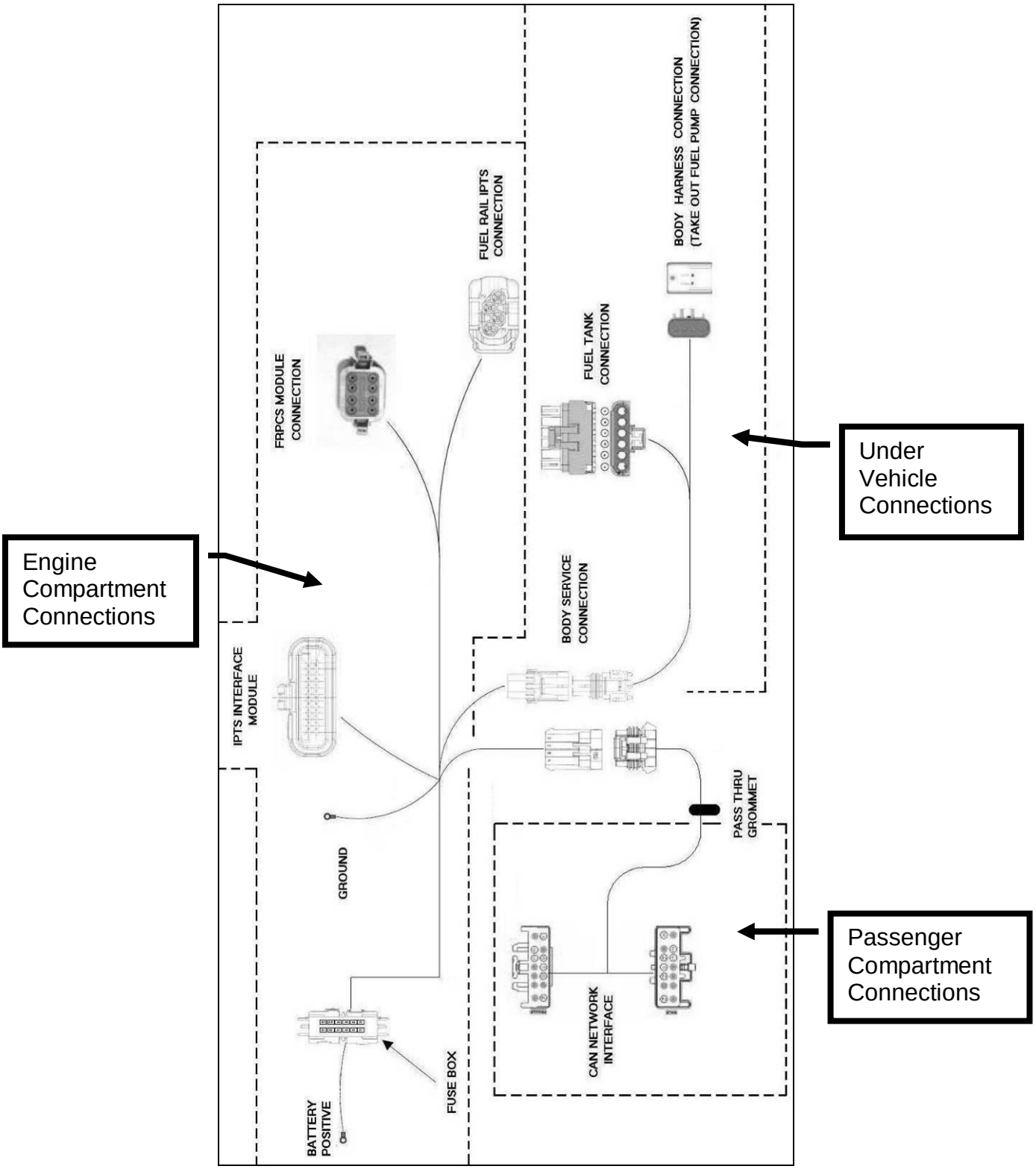
Fuel Flow



Current as of 02/11/2011

Electrical Wiring Diagrams

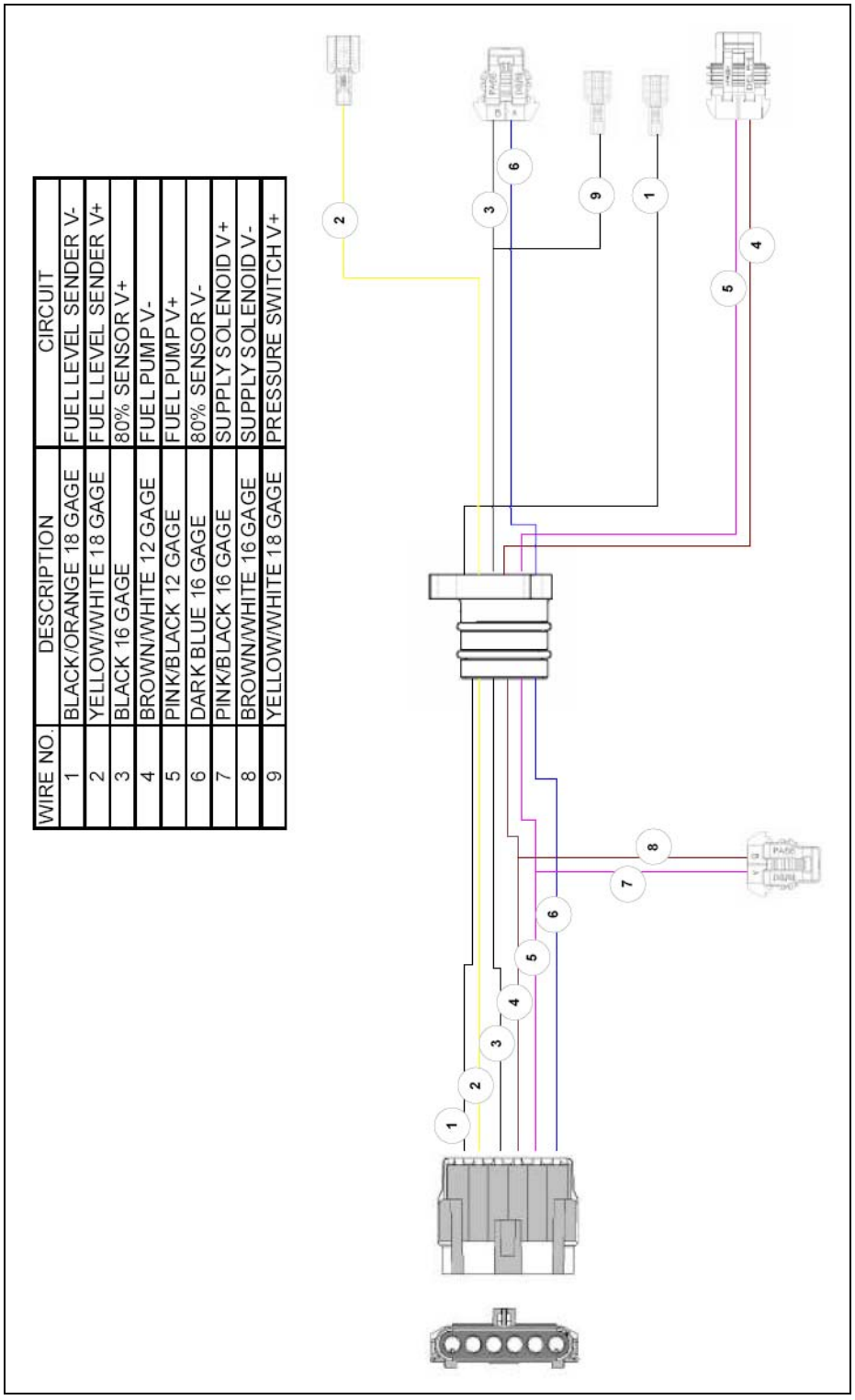
Wiring Harness Electrical Diagram



Current as of 02/11/2011

In-Tank Wire Harness

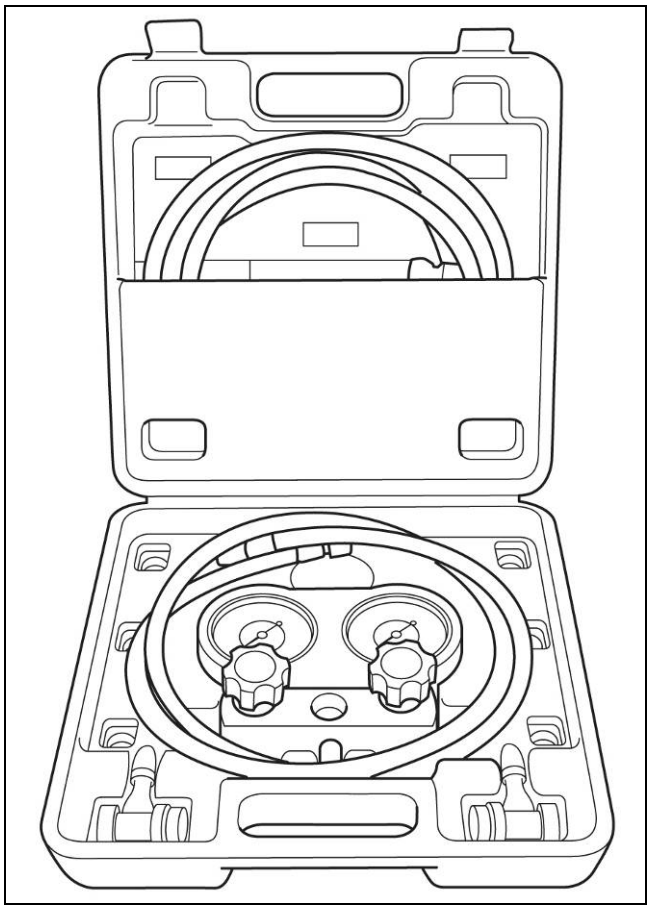
WIRE NO.	DESCRIPTION	CIRCUIT
1	BLACK/ORANGE 18 GAGE	FUEL LEVEL SENDER V-
2	YELLOW/WHITE 18 GAGE	FUEL LEVEL SENDER V+
3	BLACK 16 GAGE	80% SENSOR V+
4	BROWN/WHITE 12 GAGE	FUEL PUMP V-
5	PINK/BLACK 12 GAGE	FUEL PUMP V+
6	DARK BLUE 16 GAGE	80% SENSOR V-
7	PINK/BLACK 16 GAGE	SUPPLY SOLENOID V+
8	BROWN/WHITE 16 GAGE	SUPPLY SOLENOID V-
9	YELLOW/WHITE 18 GAGE	PRESSURE SWITCH V+



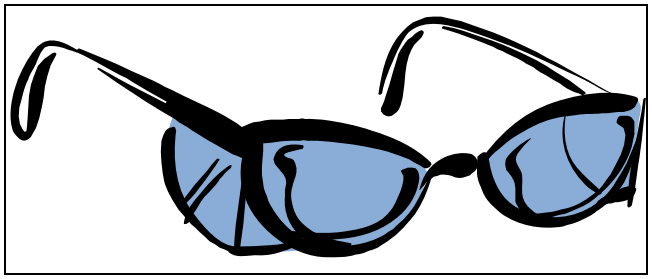
Current as of 02/11/2011

TOOLS AND EQUIPMENT

Special Tools

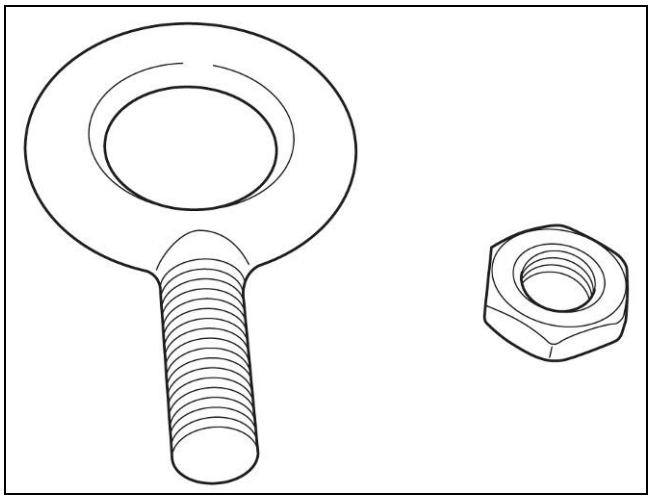


Fuel Pressure Gauge Kit (0–500 psi)

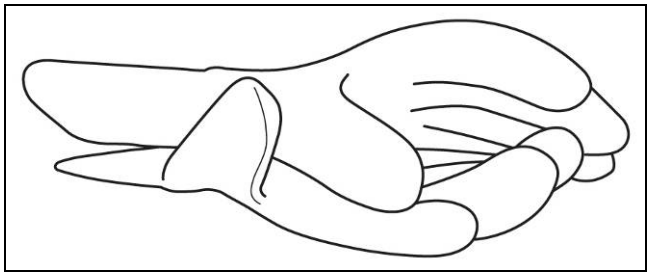


Safety Glasses

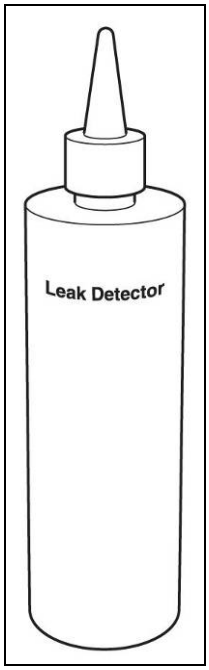
Current as of 02/11/2011



Eyebolt and 5/8"-11 Locknut



Gloves (Approved for Propane)



Liquid Leak Detector

Current as of 02/11/2011